This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

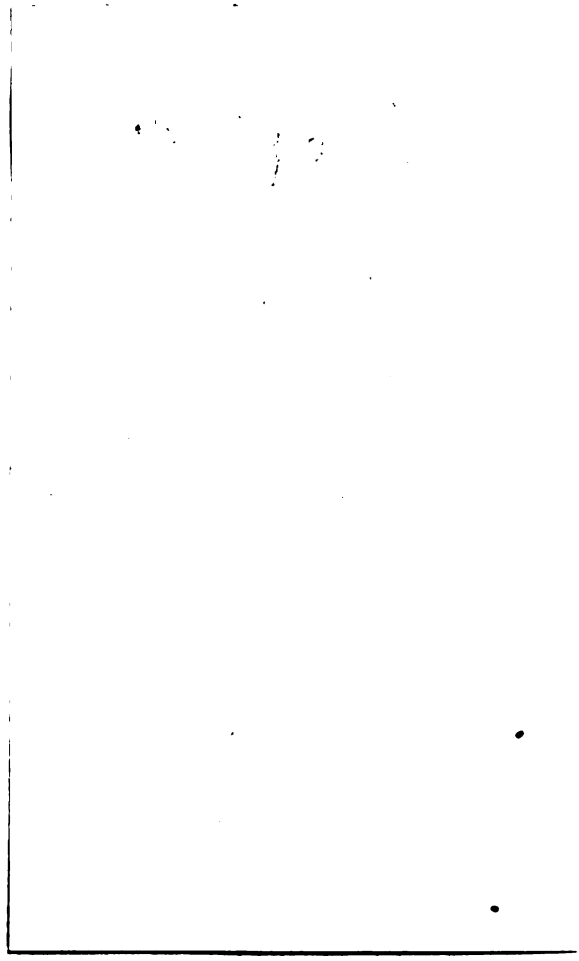
Google™ books

https://books.google.com

NYPL RESEARCH LIBRARIES
3 3433 11003 3242

Digitized by Google

Digitized by Google



Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

JAN 11 1913

THE ROYAL ENGINEERS JOURNAL.

VOLUME XVI.

JULY TO DECEMBER, 1912.

CHATHAM:
ROYAL ENGINEERS INSTITUTE.
AGENTS AND PRINTERS: W. & J. MACKAY & CO., LTD.

Digitized by Google

THE NEW YORK
PUBLIC LIBRARY
553446
ASTOR, LENOX AND
TILDEN FOUNDATIONS.
A 1913 L

VOLUME XVI.

No. 1.	JULY	Pages	1 — 80
,, 2.	AUGUST	,,	81—144
,, 3.	SEPTEMBER	,,	145—216
,, 4.	OCTOBER...	,,	217—288
,, 5.	NOVEMBER	,,	289—360
,, 6.	DECEMBER	,,	361—424

Digitized by Google

Subject Index.

Original Articles are entered in thick type; Translations, Reviews, and Notices of Magazines in thin type.

PAGE.

ABOR SUSPENSION BRIDGES, by Lieut. A. F. Chater, R.E. ... 217

ARCHÆOLOGY, THE MILITARY, OF KENT, by Major A. M. Henniker, R.E. 155

BOOKS RECEIVED 216, 360

BRIDGE REPAIRS, NOTES ON, by Capt. W. N. Borton, R.E. ... 361

CLOCKS, SYNCHRONIZATION OF, AND THE IMPORTANCE OF CORRECT TIME, by Major W. A. J. O'Meara, C.M.G., late R.E. 243

CONCENTRATION OF TROOPS BY RAIL, by Major H. F. E. Freeland, M.V.O., R.E. 219

CONSTRUCTION, ECONOMY IN: SOME SUGGESTIONS, by Lieut. E. St. G. Kirke, R.E. 377

CORRESPONDENCE:—

A Field Drawbridge, by Capt. E. K. Molesworth, R.E. 287

Note on Experimental Models of the Armstrong Propeller, by Lt.-Col. J. A. Armstrong, late R.E. 141

Roll of the Corps, by Major H. Biddulph, R.E. 349

The Story of Jerusalem, by D.C.W. 287

COST OF WELL SINKING AT THE TANGRI RIVER BRIDGE, NORTH WESTERN STATE RAILWAY, by Major E. Barnardiston, R.E. 323

DEFENCE, THE INFLUENCE OF HIGH GROUND IN, by D.O.L.F.... 83

DEMOLITION OF WIRE ENTANGLEMENTS BY MEANS OF EXPLOSIVES. (Translated from the *Injenerni Jurnal* by Lt.-Col. F. E. G. Skey, R.E.) ... 137

DRAWBRIDGE, A FIELD, by Capt. E. K. Molesworth, R.E. .. 81

ECONOMY IN CONSTRUCTION: SOME SUGGESTIONS, by Lieut. E. St. G. Kirke, R.E. 377

ELECTRIC LIGHTING FOR MOTOR CARS, by Lieut. G. L. Hall, R.E. 233

ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA, AN, edited by Comdr. the Hon. H. Shore, R.N., Retired ... 9, 93, 171, 261, 325, 399

"ESSAY ON THE MILITARY POLICY OF THE BRITISH EMPIRE," PASLEY'S — CONTEMPORARY CRITICISMS, 1810—1813, by Col. B. R. Ward, R.E. 23

Digitized by Google

PAGE.

FIELD DRAWBRIDGE, by Capt. E. K. Molesworth, R.E. 81
FIELD TROOP SUMMER TRAINING, 1912, compiled by Capt. H. J. Elles, R.E. 289
FIRE BRIGADE APPARATUS, MOTOR, by Capt. E. H. Harvey, late R.E. 391

GIBRALTAR, A LADY'S EXPERIENCES IN THE GREAT SIEGE OF, by Col. E. R. Kenyon, R.E. 31
GIBRALTAR, SOME ENGINEER ORDERS AT THE SIEGE OF ... 87
GIRDER, A PORTABLE FIELD, AND METHOD OF LAUNCHING, by Bt. Major R. L. McClintock, D.S.O., R.E. 1
GRAVITATIONAL SHUNTING, by Lieut. J. W. J. Raikes, R.E. ... 315
GROUP SYSTEM OF FORTIFICATION APPLIED TO FORTRESSES. (Translated from the *Injenerni Jurnal* by Lt.-Col. F. E. G. Skey, R.E.) ... 67

HIGH GROUND, THE INFLUENCE OF, IN DEFENCE, by D.O.L.F.... 83
HISTORICAL DOCUMENTS OF MAJOR-GENERAL SIR J. T. JONES, BART., K.C.B., R.E.... 107

INFLUENCE OF HIGH GROUND IN DEFENCE, by D.O.L.F. ... 83

JONES, HISTORICAL DOCUMENTS OF MAJOR-GENERAL SIR J. T., BART., K.C.B., R.E. 107

KENT, THE MILITARY ARCHÆOLOGY OF, by Major A. M. Henniker, R.E. 155

LADY'S EXPERIENCES IN THE GREAT SIEGE OF GIBRALTAR (1779-83), A, by Col. E. R. Kenyon, R.E. 31

MECHANICAL TRANSPORT FOR MILITARY PURPOSES, by Capt. R. K. Bagnall-Wild, late R.E.... 371
MEMOIRS:—
Gen. Sir Alexander Taylor, G.C.B., by Col. Sir Edward Thackeray, V.C., K.C.B., late R.E. 51
Major-Gen. E. R. Festing, C.B., F.R.S., by Col. Sir C. C. Scott-Moncrieff, K.C.S.I., K.C.M.G., LL.D., late R.E. 121
Lt.-Col. A. C. Smith, R.E., by H.M.V. 61
Lt.-Gen. Sir Gordon D. Pritchard, K.C.B., Colonel Comma dant, R.E. 183

Digitized by Google

PAGE.

MILITARY ARCHÆOLOGY OF KENT, THE, by Major A. M. Henniker, R.E. 155
MOTOR CARS, ELECTRIC LIGHTING FOR, by Lieut. G. L. Hall, R.E. 233
MOTOR FIRE BRIGADE APPARATUS, by Capt. E. H. Harvey, late R.E. 391
MY RECOLLECTIONS OF AN INDIAN BATTLEFIELD, by Capt. M. Power ... 125

NOTES ON BRIDGE REPAIRS, by Capt. W. N. Borton, R.E. ... 361
NOTES ON WIND PRESSURE ON ROOFS, by Lieut. C. R. Satterthwaite, R.E. 385
NOTICES OF MAGAZINES:—
Revue Militaire des Armées Étrangères, by Lieut. A. H. Scott, R.E. ... 76, 284
Rivista di Artiglieria e Genio, by Col. Sir Edward T. Thackeray, V.C., K.C.B., late R.E. 78, 205, 285, 419
Kriegstechnische Zeitschrift, by Capt. C. Otley Place, D.S.O., R.E. ... 203
Engineering 208
Revue d'Artillerie, by Lt.-Col. A. R. Reynolds, R.E. 411

ORDERS, SOME ENGINEER, AT THE SIEGE OF GIBRALTAR ... 87

PASLEY'S "ESSAY ON THE MILITARY POLICY OF THE BRITISH EMPIRE"—CONTEMPORARY CRITICISMS, 1810—1813, by Col. B. R. Ward, R.E. 23
PEMBA, THE SURVEY OF, by Capt. J. E. E. Craster, R.E. ... 145
PENINSULA, AN ENGINEER OFFICER UNDER WELLINGTON IN THE, by Comdr. the Hon. H. Shore, R.N., Retired... ..
9, 93, 171, 261, 325, 399
PORTABLE FIELD GIRDER, A, AND METHOD OF LAUNCHING, by Bt. Major R. L. McClintock, D.S.O., R.E. 1

RAIL, CONCENTRATION OF TROOPS BY, by Major H. F. E. Freeland, M.V.O., R.E. 219
RECENT PUBLICATIONS OF MILITARY INTEREST 209, 350
REPORT ON ARTIFICIAL ILLUMINANTS, OTHER THAN ELECTRIC, SUITABLE FOR BARRACKS, WORKSHOPS AND LARGE OPEN SPACES, by Capt. L. N. Malan, R.E. 187, 273
REVIEWS:—
Building Construction, by Charles Mitchell. (A.S.R.) 410
Building Construction and Drawing, by Charles Mitchell. (A.S.R.) ... 410
Gunnery, by Capt. J. C. Wise, U.S.A. Volunteers. (C.E.P.) 409
Military Hygiene and Sanitation, by Col. Melville, R.A.M.C. (A.M.H.)... 283
The Civil Engineers' Cost Book, by Major T. E. Coleman, Staff for R.E. Services 75
The Principles of Structural Mechanics, by Percy J. Waldram. (A.S.R.)... 409
The Ruins of Mexico, by Constantine G. Rickards 75
The Story of Jerusalem, by Col. Sir C. M. Watson, K.C.M.G., C.B., late R.E. (E.H.H.) 201
ROOFS, NOTES ON WIND PRESSURE ON, by Lieut. C. R. Satterthwaite, R.E. 385

Digitized by Google

PAGE.

SHUNTING, GRAVITATIONAL, by Lieut. J. W. J. Raikes, R.E. ... 315

SOURCE OF THE NILE, by Col. Sir C. M. Watson, K.C.M.G., C.B., late R.E. ... 337

SPECIALIZATION OF ENGINEER SERVICES IN THE AUSTRIAN ARMY, by Major A. H. Ollivant, G.S. 271

SUMMER TRAINING, FIELD TROOP, 1912, compiled by Capt. H. J. Elles, R.E. 289

SURVEY OF PEMBA, by Capt. J. E. E. Craster, R.E. 145

SUSPENSION BRIDGES, ABOR, by Lieut. A. F. Chater, R.E. ... 217

SYNCHRONIZATION OF CLOCKS AND THE IMPORTANCE OF CORRECT TIME, by Major W. A. J. O'Meara, C.M.G., late R.E. 243

TRANSPORT, MECHANICAL, FOR MILITARY PURPOSES, by Capt. R. K. Bagnall-Wild, late R.E. 371

WELL SINKING, COST OF, AT THE TANGRI RIVER BRIDGE, NORTH WESTERN STATE RAILWAY, by Major E. Barnardiston, R.E. 323

WIND PRESSURE ON ROOFS, NOTES ON, by Lieut. C. R. Satterthwaite, R.E. 385

Digitized by Google

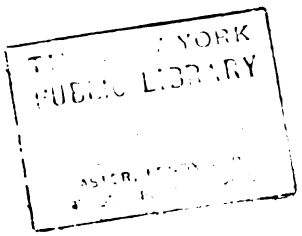
Index to Authors.

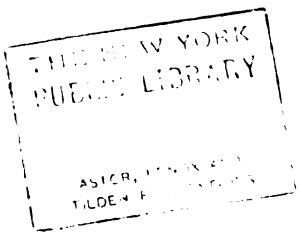
(*Memoirs and Reviews Omitted.*)

	Page.
Armstrong, Lt.-Col. J. A. ...	141
Bagnall-Wild, Capt. R. K. ...	371
Barnardiston, Major E.... ...	323
Biddulph, Major H.	349
Borton, Capt. W. N.	361
Chater, Lieut. A. F.	217
Craster, Capt. J. E. E.	145
D.C.W.	287
D.O.L.F.	83
Elles, Capt. H. J....	289
Freeland, Major H. F. E. ...	219
Hall, Lieut. G. L....	233
Harvey, Capt. E. H.	391
Henniker, Major A. M.	155
Kenyon, Col. E. R.	31
Kirke, Lieut. E. St. G.	377
McClintock, Bt. Major R. L. ...	1
Malan, Capt. L. N. ...	187, 273
Molesworth, Capt. E. K.	81, 287
O'Meara, Major W. A. J. ...	243
Ollivant, Major A. H.	271
Place, Capt. C. Otley	203
Power, Capt. M.	125
Raikes, Lieut. J. W. J.	315
Reynolds, Lt.-Col. A. R. ...	411
Satterthwaite, Lieut. C. R. ...	385
Scott, Lieut. A. H. ...	76, 284
Shore, Comdr. the Hon. H. ...	9, 93, 171, 261, 325, 399
Skey, Lt.-Col. F. E. G. ...	67, 137
Thackeray, Col. Sir Edward ...	78, 205, 285, 419
Ward, Col. B. R.	23
Watson, Sir C. M...	337

Digitized by Google

Digitized by Google





Digitized by Google

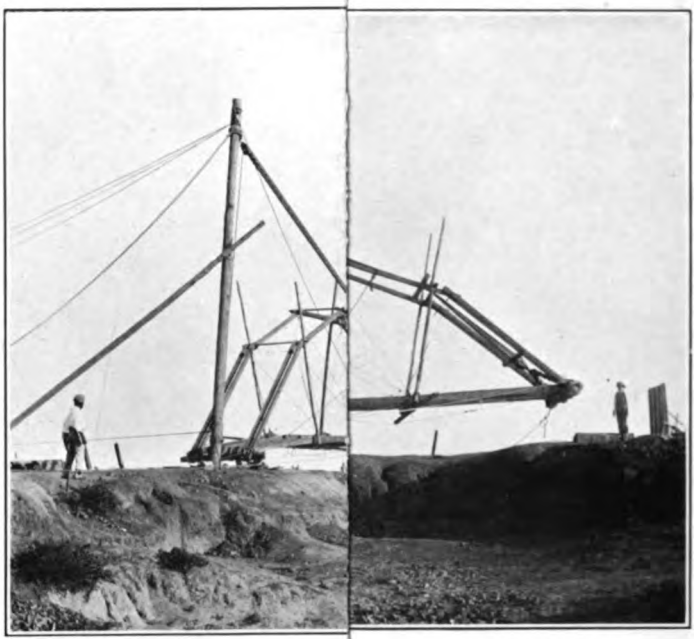


Photo 1.—Bridge put together ansom over Far Bank.

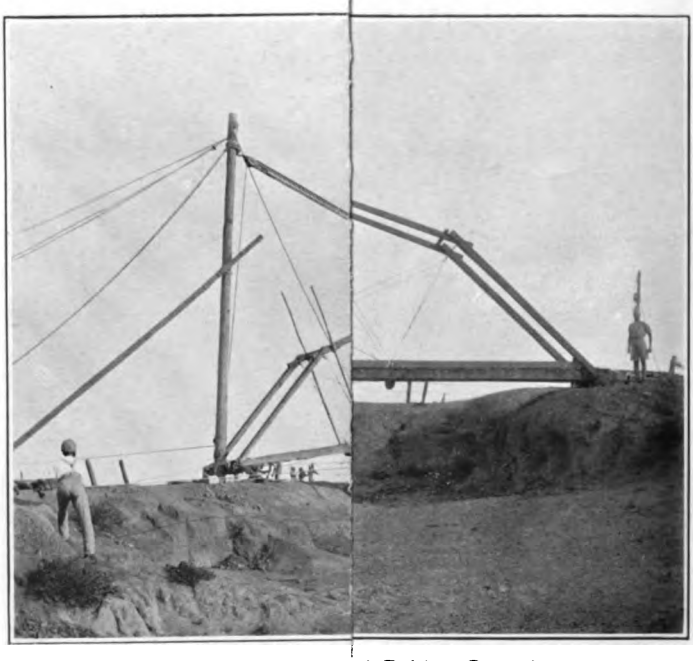


Photo 2.—Swing d Bridge Completed.

Digitized by Google

A PORTABLE FIELD GIRDER, AND A SIMPLE METHOD OF LAUNCHING.

By Bt. Major R. L. McClintock, d.s.o., R.E.

As a good deal has recently appeared in the *R.E. Journal* on the subject of field girder bridges, the following account of certain experiments with such a girder bridge carried out by the Q.V.O. Sappers & Miners at Bangalore may prove of interest.

Part I.—*The Girder.*—The original idea was taken from a French book,* in which it is referred to as "Le Pont du Système Tarron."

The inventor claims for it :—

(1). That it contains only materials readily available in a civilized country, and that it can be turned out with the tools carried by a Field Company of Sappers.

(2). That the whole of the launching operations can be carried out from the near bank.

(3). That it will cross spans up to 45 metres.

If indeed a field girder could be devised to fulfil all the above conditions it might be worth adding to existing bridging equipment, seeing that it is applicable to any gap, wet or dry, shallow or bottomless ; especially if it could also

(4). Be quickly and easily taken to pieces and assembled by comparatively unskilled men.

(5). Have no part too long to pack in a G.S. wagon or too heavy for two men to lift.

Instance of Use.—The French authors give the following instance of the use of this type of bridge in practice :—

At Bozel in 1904 a sudden flood of a local torrent swept away the bridge on the high road and interrupted all traffic with the South. Lieut. Delacroix of the 4th Genie was forthwith sent to Bozel with 74 Sappers and ordered to restore communication by means of a Tarron bridge. This had to cross a clear span of 20 metres and carry a concentrated load of 3 tons. He was given the job on 25th July and began work on the morning of the 26th. He felled his timber in a wood 3 miles off and carted it to site, where his 74 men worked it up. These had never made a Tarron girder bridge before, but nevertheless completed their work by 11 a.m. on the 30th, and launched the bridge the same day—in all 72 hours work.

* *Ponts Improvises, Ponts Militaires et Ponts Coloniaux.* Par G. Espitallier et F. Durand (Octave Doin et Fils, Paris).

Digitized by Google

General Mechanical Principles.—The general principles of the Tarron design are best quoted from the authors (*vide Fig.* 1) :—"If we consider a series of rigid bars forming, with respect to the horizontal, the funicular polygon MABCDM′, extending from one bank to the other, this system is of itself in equilibrium, and this becomes stable if we join the different angles to the central point of MM′ by ties. Thus we make a girder which, joined to a second similar girder, can carry the roadway of a bridge. Lateral stability is obtained and the whole linked up into one rigid system by joining the overhead angles of the two girders by horizontal transverse struts *m* and by diagonal ties *n*.

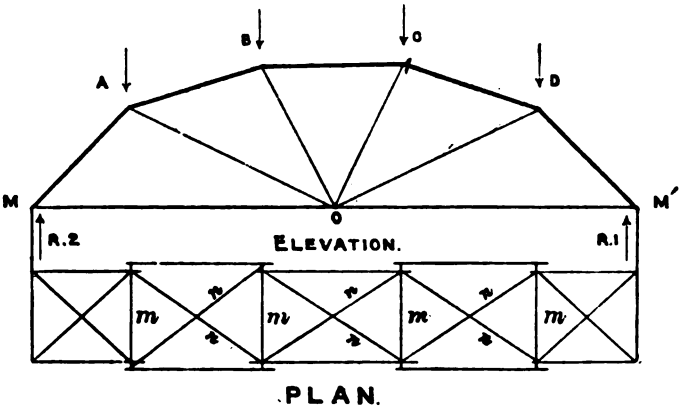


FIG. 1.—"*Tarron*" *Girder—General Principles.*

Length of Components.—The design of the Tarron girder bridges made at Bangalore was based on the following assumptions :—

(1). That the angles made by the two end compression members (MA and M′D) with the horizontal was 45°. (There was no special reason for this particular angle : the French authors suggest 50° as the most economical).

(2). That there should be five compression members of equal length in the arch of each girder.

These two conditions, taken in conjunction with the particular span, at once fix the length of all components of the girders.

Bangalore Experiments.—In the Bangalore experiments a 30′ girder bridge was first made, chiefly to see how the joints worked out and to experiment with the Tarron system of launching from one bank by "Contrepoids et Avancement," of which more later under the head of Method A. The book did not afford much practical help in the actual construction of the girders, as it omitted to give any dimensions or data, and refrained from the description of any joint or other working detail. As in addition the only drawings given were

Digitized by Google

those reproduced as *Figs.* 1, 2 and 4, it is quite possible that the

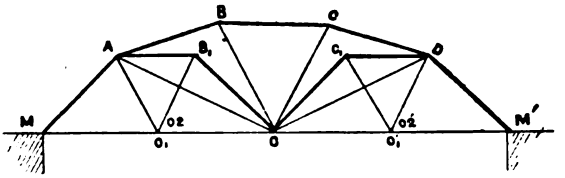


FIG. 2.—"*Tarron Girder*"—*Showing Subsidiary Girders for Large Spans.*

girder finally evolved at Bangalore differed materially from that of Bozel.

However, the scantlings of the various tension and compression members were obtained by the aid of a stress diagram, and the joints, etc., evolved from imagination tempered by experience. The resulting 30′ bridge proving quite successful and having been loaded to destruction, a 60′ bridge on the same principle was put in hand, to carry infantry in file, or loaded pack animals.

Multiple Jointed Tie-Beam.—This extension of span at once introduced a difficulty. 15′ or 16′ being the longest spar which can conveniently be carried in a G.S. wagon, it was obvious that the 60′ tie-beams of the new girders must now be made in at least four parts, thus giving the three joints OMN (*Fig.* 3) to be held up, instead of only one in the middle, as in *Fig.* 1. The French inventor overcomes this difficulty by the introduction of two "subsidiary girders"—MAB_1O and M_1DC_1O (*Fig.* 2) to hold up the two joints O_1 and O'_1, on either side of the centre.

Difficulty of Subsidiary Girders.—Neither the original drawings nor the letterpress gave any information as to how the joints were worked at A and D (*Fig.* 2), where the main and subsidiary girders blend into one. This proved a difficulty in practice, and there seemed no reason why this redundant and weighty arrangement of subsidiary girders should not have its object fulfilled much more simply by four new wire ties—OC, OD and NC, ND (*Fig.* 3). This arrangement

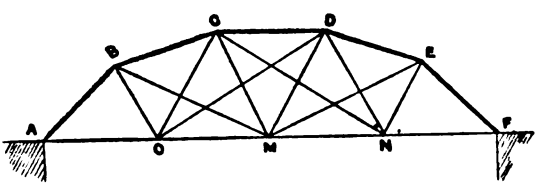


FIG. 3.—*Bangalore Girder—Showing Additional Ties for Large Spans.*

incidentally also relieves the stresses in some of the members very materially.

Digitized by Google

Span, Load and Scantlings.—The 60′ span bridge was accordingly made on these modified lines, the modification being re-christened the "Bangalore Girder" (*Fig.* 3).

Span, 60′.
Roadway, 6′ in clear.
Headroom, 10′.
Load, infantry in file—*i.e.* 1¼ cwt. per foot-run on each of the two girders.

Each of these consisted of the following parts :—

(1). Five compression members, AB, BC, CD, DE, EF (*Fig.* 3). Being in compression, these were of course made of wood, and were 14·08′ long between centres of pin-joints, and 15′ overall. They were made alternately of a single piece of 5″ × 5″ timber, and two pieces of 5″ × 4″. This was done solely to ensure a direct thrust down each member, as otherwise the double compression members (AB, CD, EF) were very wasteful of weight as compared with the single ones (BC and DE, *Fig.* 3).

(2). Ten wire ties of 1″ steel cable, of varying lengths. OB, OC, OD—MB, MC, MD, ME—NC, ND, NE (*Fig.* 3). As these never come into compression, they are made of wire.

(3). One tie-beam, composed of the four sections AO, OM, MN, NF (*Fig.* 3), each 15′ long between centres of pin-joints, and 17′ overall. Although these are in tension when the bridge is under a load, during the operation of launching they come into compression, and consequently must be made of wood. Each of these was a single piece of 8″ × 2″.

(4). All joints were "pin" joints of round mild steel rod, 1″ in section. To each of these a "U"-shaped shackle was fitted, to facilitate the attachment of the wire ties to the various angles.

Connecting Girders into Bridge.—The two girders, prepared as above, were then connected together—

(*a*). Underneath the tie-beams.
(*b*). Overhead along the arch of the compression members.

(*a*). The two tie-beams were cross-connected by two shore transoms (A and F) and three road transoms (O, M, N), each 8′ long by 8″ × 4″ bolted on underneath them. These five transoms carried two lines of roadbearers, of the same depth as the tie-beams, and consequently having their top edges flush with them. The chesses were accordingly supported at four points—on the two tie-beams at their ends, and on the two roadbearers in between.

(*b*). Overhead the two girders were cross-connected by four horizontal transverse struts between the angles BB, CC, DD, EE on the two girders, and by diagonal wire bracing, as shown in the three centre bays of *Fig.* 1, *Plan—n, n, n.*

Digitized by Google

Weight of Complete Bridge.—The total weight of the whole bridge (less chesses) proved to be 5,436 lbs. and that of the heaviest member 185 lbs. This was quite unnecessarily heavy, the timber used being "Honay" (*Pterocarpus Marsupium*), which weighs 56 lbs. a cubic foot, as against elm which weighs only about 34 lbs. Also the scantlings for the compression members were calculated from a formula which allows a very large factor of safety. There is no doubt that the bridge could have been made considerably lighter with safety.

PART II.—*Launching.*—"*Method A*," "*par Contrepoids.*"—This is the arrangement advocated in the book. The bridge, which can easily be carried by about 100 men, is brought up to the gap and laid down parallel to the near bank, and as close to it as possible. The rest of the operation is best described in a free translation of the book (*Fig.* 4):—"The bridge is prolonged in rear of the shore transom M by a frame making an acute angle with the horizontal. This frame can be loaded on its end with a counterpoise which will balance the weight of the bridge round the shore transom M. A cable runs from the end of the counterpoise over cross-pieces at the ends of arms which stand at intervals on the bridge, and this cable is finally made fast to the far end of the bridge. If the lengths of the various arms are correctly arranged, the stresses in all the ties of the girders remain tensions (this is essential) except in the horizontal tie-beams, which come into compression. As, however, this compression is not great and these tie-beams are of wood of a fairly large cross section, it does not have any ill-effect. The operation of launching consists in turning the whole system round a vertical axis, so as to bring the bridge across the gap. The counterpoise is then allowed to rise, and the outer shore transom settles into its place on the further bank. The various launching accessories are then dismantled."

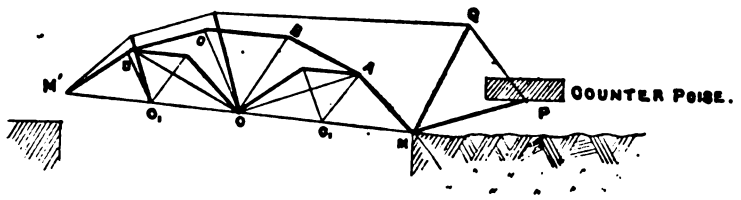


FIG. 4.—"*Tarron Girder*"—*Launching Method A.*

"*Method B*," *by Single Derrick.*—Finding the counterpoise difficult to arrange for the long and heavy 60′ bridge (and not caring much for the method anyhow, for various practical reasons which will at once become apparent to anyone who tries it), we endeavoured to discover some other method of attaining the same result. The device finally adopted as simpler and quicker than all others was a single derrick on the near bank. *Figs.* 5 and 6 and *Photos* 1, 2, 3 explain the method. The bridge, as before, is placed parallel and as close

Digitized by Google

as possible to the near edge of the gap, with the near shore transom resting on the ground across what will be its final position. The bridge, of course, may be made *in situ*, or constructed under cover and carried up at the last moment.

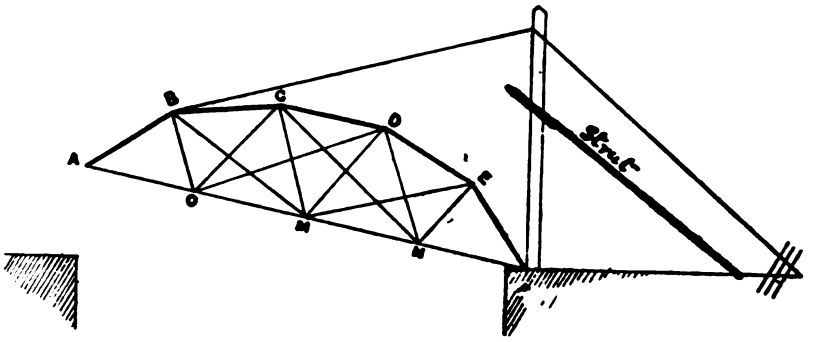


FIG. 5.—*Bangalore Girder—Launching "Method B."*

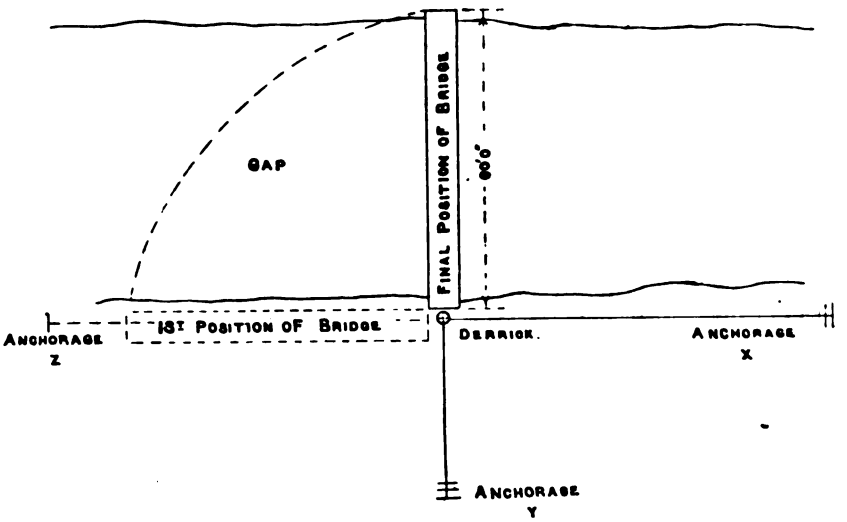


FIG. 6.—*Plan of Launching Arrangements—Bangalore Girder—"Method B."*

In the meantime another party erects a single derrick of any convenient height (that in the photos was 30′, but as little as 20′ will do at a pinch) just in rear of what will be the final position of the near shore transom (*vide Figs.* 5 and 6). If men cannot cross the gap, the fore-guy must be replaced with a back strut, as in the photos. A treble tackle connects the head of the derrick with the far end of the bridge. A suitable tree can replace this derrick entirely.

When all is ready, 30 men haul on the fall of the tackle, the outer shore transom rises in the air, and the near shore transom butts hard up against the foot of the derrick. The whole bridge can now be

Digitized by Google

pivoted on this point and swung round through a right-angle, till the far shore transom is vertically above its final position on the far bank. If the tackle is now slacked off gently, the bridge settles down across the gap. It can be moved a little forwards or backwards as required by a few men hauling on a rope at either end.

During the operation of launching, the stress at first is taken entirely by the anchor X, and is then gradually transferred to the anchor Y, *Fig.* 6. These two anchors thus represent the Frenchman's counterpoise. These two anchorages should be made rather stronger than those normally used for a single derrick ; in sound soil they may be of 3 : 2 : 1 park picket pattern, well driven home. The third guy Z takes little stress and may be secured to a single picket, while the fore-guy may be replaced by a back strut.

Time and Men.—The 60′ girder bridge, weighing 5,436 lbs., was launched by the above method within seven minutes by a squad of 40 native recruits. This was, of course, exclusive of the time taken in raising the derrick, which proceeds contemporaneously with the putting together of the girders. The former operation has been carried out at Bangalore by 50 men in three hours, while on the first occasion of putting together the bridge, 30 men totally unacquainted with it completed the work in four hours. Hence the putting together and launching of a 60′ girder bridge of this type would appear to represent about four hours work for 80 men.

Launching Expedients.—This girder bridge, rigid enough when finally *in situ* and under a load, has a tendency to deform during launching in two distinct directions. First, the three joints O,M,N (*Fig.* 3) in the horizontal tie-beams may rise out of the horizontal. If this is allowed to happen, the whole affair will shut up, and it must be guarded against by lashing temporary struts across each girder between B and O, M and C, and N and E (*Fig.* 3). These struts may be seen in *Photos* 1, 2 and 3 ; they are removed when launching is complete. Secondly, the long and willowy bridge sometimes has a tendency to buckle longitudinally under the pull of the tackle. This can be prevented by cross-bracing the tie-beams with three small spars and a little rope. This is also shown in *Photos* 1, 2, 3, and is likewise removed once the bridge is across the gap.

Final Remarks.—1. *Girder.*—Among other good points in this type of girder bridge is the absence of any strut or other projection below the roadway level. Consequently the erection of high abutments to raise the bridge clear of the water level is not necessary. It may possibly be objected that large proportion of depth to span (1 to 4) and the consequent height of the girders (about 15′) will make them difficult to handle. This has not been found to be the case, each separate girder being light enough to be put together on the ground, raised into a vertical plane, and then joined to its fellow without any special arrangements being necessary.

Digitized by Google

2. *Method of Launching.*—It is claimed that "Method B" compares very favourably as regards time and simplicity with any of the other methods of field girder launching in common use. These, I imagine, are fairly summarized in the table at the end of "Method of Launching recommended for Large Girder Bridges" in the November number of the *R.E. Journal*, 1911. All instances given therein of the launching of girder bridges of 40′ span and over, apparently required access to the far bank of the gap, and entailed the erection thereon of some structure, varying from a 30′ sheers to a 60′ derrick—(and usually some other structure on the near bank also)—or the passing across the gap of a couple of suspension cables. In launching by "Method B," on the contrary, until the far shore transom is at rest in its final position on the far bank, there is no necessity for any man to set foot on the latter. He can then cross on the girders. Further, the only launching accessories required are a simple single derrick of moderate height on the near bank. This method seems suitable to any girder bridge which is of fair longitudinal stiffness, or which can be stiffened temporarily, as was done to the "Bangalore" girder bridge in question.

It has been objected that this swinging method of launching is not universally applicable—for instance, to the case of a gap across a highly embanked road, where the bridge could not be constructed along the near bank, at right angles to its proposed final position. The "Method B" has accordingly been developed as follows to meet this case also.

The bridge is put together as before, but *on the road itself* in rear of the derrick (pointing in the direction of anchorage Y, *Fig.* 5). The far end is raised as before by the tackle, and the whole bridge swung round *in a complete semicircle* still in the position required. This necessitates a fore-guy across the gap, and a little manœuvring of the side-guy to anchorage Z as the bridge passes beneath it, but no other modification whatever.

The bridge was launched under these conditions also at Bangalore, the time taken being about 15 minutes.

I owe my acknowledgments to Quartermaster-Sergeant Instructors King and Dolan of "Queen Victoria's Own" Sapper and Miners, the former of whom rendered me much assistance in the construction of the girder bridge, and the latter in the perfecting of the launching arrangements. The photographs are by C.S.M. Pickles of the same Corps.

Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

THE DIARY AND CORRESPONDENCE OF LIEUT. RICE JONES, R.E., DURING 1808-9-10-11-12.

WITH LETTERS FROM DISTINGUISHED OFFICERS AT THE SEAT OF WAR IN PORTUGAL, SPAIN, FRANCE, BELGIUM, AND AMERICA AND AFTERWARDS.

(*Edited by* CAPT. THE HON. H. V. SHORE, LATE R.N.).

INTRODUCTORY.

IT is meet and right that we should be reminded, from time to time, of the protracted and exhausting struggle that was maintained by our forebears a hundred years ago, on behalf of the Peninsular nations and in the cause of European freedom, against the Napoleonic usurpation. And no form of reminder proves more acceptable than the personal experiences of men who bore a part in that momentous struggle. For these narratives—no matter how defective they may be from a literary point of view—convey a much more vivid picture of war; the hardships, sufferings, and strenuous labours of those engaged, to say nothing of the miseries, most patiently endured, by the innocent and unoffending inhabitants of territories involved, than can be derived from the nicely balanced sentences, the polished periods, and the fine language of the professional historian, be he never so learned.

The author of the Diary and Letters, which form the groundwork of the present series, first embarked for foreign service with General Whitelocke's ill-starred expedition to Buenos Ayres. But the operations having been brought to a close before his arrival, there was nothing to be done but to return home, where, shortly afterwards, he was a witness of the landing at Falmouth, of some of the débris of Sir John Moore's unfortunate army. He was now ordered to Portugal, and joined the army which was assembling at Coimbra, just before the arrival of Sir Arthur Wellesley to take command, for the second time, of the British forces in the Peninsula. During the Oporto Campaign which ensued, he was on the staff of Colonel Fletcher, the Commanding Royal Engineer, which brought him into close attendance on Sir A. Wellesley during the whole of the operations. During the Talavera Campaign, he enjoyed the same privileged position; and as soon as Sir Arthur had decided, in consultation with his Chief Engineer on the construction of that tremendous defensive

Digitized by Google

position across the Lisbon peninsula, he found employment during the winter of 1809–10 in superintending the works destined to form the western end of the afterwards famous "LINES OF TORRES VEDRAS." During the summer of 1810, the work on the Lines being well advanced, our diarist accompanied his commanding officer to rejoin the army in the field, *vis-à-vis* of Massena's invading host, and was present, in close attendance on Lord Wellington, at the Battle of Busaco, and during the operations connected with the retreat of the allied forces within the Lines. Following in the wake of Massena's retreat, in the spring of 1811, he took part in the first abortive Siege of Badajoz; accompanied his commanding officer to the field of Albuera, which was reached just at the close of the action; took part in the second Siege of Badajoz; and after it was raised, joined the Light Division, and, during the remaining months of 1811, was on the staff of General Robert Craufurd whom he accompanied on his many hazardous reconnaissances around Ciudad Rodrigo. By the directions of that officer he accompanied the storming party of the Light Division, at the assault of Ciudad Rodrigo, in January, 1812, on which glorious occasion (to quote his own words) "he had the good fortune to lead the 52nd and 43rd Regiments to a small breach, to the left of the large one." Of this exploit, our diarist supplies the briefest and most modest narrative that was probably ever penned by a son to his father. This thrilling episode formed a fitting conclusion to his service with the Peninsular Army. He returned home immediately afterwards, to take up the post of Adjutant at Woolwich, where, later, he performed the duties of Brigade Major; and after holding various responsible posts in Nova Scotia, Dover and Malta, he died at the age of 64, when Commanding Royal Engineer at Gibraltar, in 1854.

Not the least of the interest attaching to these records of war service is the fresh light they throw on many disputed points, and especially on the personal qualities and disposition of the celebrated leader of the Light Division, General Robert Craufurd, with whom our diarist would seem to have been on terms of the closest intimacy during several months, at a critical stage of the war, and whose loss at the storm of Rodrigo he deplores in almost affectionate words. It will certainly be news to most people to learn that that fiery warrior, and stern disciplinarian "kept one of the best tables in the army."

During his service in the Peninsula, the diarist contracted many warm and lasting friendships; not alone with his contemporaries, but with officers of standing under whom he served, and who continued to correspond with him up to the time of his death. The friendly and intimate letters written by his late chief, Sir Richard Fletcher, Sir J. T. Jones, and Sir John Burgoyne, from the seat of war, to the young Adjutant of Engineers at Woolwich (he was only 23 when he took up the post) are by no means the least illuminative, or interesting portion of the volume. The last of the series is from

Digitized by Google

that distinguished Engineer, Sir John Burgoyne, on the eve of the Crimean War, in which struggle he was destined to play a prominent part.

Rice Jones, the author of the Diary, was born May 29th, 1788. Electing to follow his father's profession he was placed, in due course, at the Royal Military Academy, Woolwich, whence he joined the Royal Engineers, January, 1807.

That the educational requirements of a youth, on entering the Academy, in those distant times, were not of a high order may be gathered from some letters written by a young Engineer officer, while serving under the Duke of York, in the Netherlands, to a near relative, with reference to the entry of his younger brother at the Academy :—

CAMP NEAR EN LE FONTAINE,
October 22nd, 1793.

I had a letter from my mother by last post, in which she tells me that the Duke had written to her, that he would make Kenneth a Cadet in February. As a great deal depends on getting off well at first, I shall write you a few instructions about what he should learn, which you will be so good as to communicate to his master. He must pay particular attention to his Arithmetick. I suppose he is already master of the Rule of Three. He must next learn Vulgar and Decimal Fractions with the Extraction of the Square and Cube Roots. This is what he is required to know to qualify him for admission into the Academy. So that he must be master of these before he goes on farther. After that he may learn Arithmetical and Geometrical Progression with Single and Double Position. Get for him *Hutton's Arithmetick*, as it is the book taught in the Academy, and if he learns another the Masters will probably make him begin over again. As he goes on he must write the Rules and Examples in a book, and take care to keep it clean and neatly written : this he must show when examined for admission to the Academy. I would not have him discontinue his Latin, (though the principal attention should be paid to his Writing and Arithmetick), it will facilitate his learning other languages ; and the learning passages by heart will strengthen his memory, and will be of great service to him in getting thro' the Academy. As to French, he had better not begin it till he gets to the Academy ; for what he could learn now would not be of much service to him, considering the change of Masters and Grammers, except he has much spare time on his hands. If he pays attention to his studies, and is not idle when he first goes to the Academy, he may have an opportunity of getting before many of those who are admitted at the same time, which will make the difference of years when he gets to the top of the Academy.

A month later he returns to the subject :—

GHENT, *November 29th*, 1793.

I wrote to you some time ago, I hope you got the letter, as it mentioned something about Kenneth's studies—understanding from my mother that he is going to Woolwich in February. I would have him now transcribe

Digitized by Google

from *Hutton's Arithmetick* (beginning with Vulgar Fractions) what I mentioned in my last letter, in a Folio Blank Book. If he writes this well and keeps his book clean, it may be allowed to pass when he goes to the Academy. This will advance him four or five months, besides is a great thing, as they now remain so short a time at the Academy. This is a good time to go there; a number of commissions are now vacant, and more likely to be won, as an augmentation of Artillery is going to take place; indeed the Duke has been obliged to give away nine to people who have not been to the Academy. . . .

Writing again, under date, October 8th, 1795, he says:—"I have seen Kenneth. He has been very idle and near been dismissed; but I believe is now doing better, and I hope will get away before next summer. . . ."

(NOTE.—Before three years had passed, both these fine young men—one in the Royal Engineers, the other in the Artillery, had succumbed to yellow fever in the West Indies).

The Diaries, which form the groundwork of the following pages, are in a clear, small, copperplate handwriting, often so minute as almost to require the aid of a magnifying glass for their elucidation, but all penned with equal care, whether in barracks at home, or on active service in the field. Whence may be inferred a love of method, neatness, regularity, and perseverance. The first entry bears the date, January 19th, 1807; the last, December 31st, 1816; and the whole are contained in three small note-books, bound in red.

The first three months of service were passed uneventfully at headquarters, at Chatham, whence frequent excursions on horseback were made to Hythe, where a brother resided. Once, he made a trip, "with Capt. Cunningham, Royal Engineers, to see the towers and works on the coast." The *raison d'être* of these works, which had been carried out by the eminent engineer, George Rennie, and would naturally be of considerable professional interest to a young officer of the scientific Corps, is thus explained by Smiles, in *The Lives of the Engineers*. During the invasion scare of 1803, Mr. Rennie, as the first engineer of the day, was invited by Government to draw up a scheme for flooding the valley of the Lea:—the eastern side of the metropolis being considered the most accessible to an invading force landing at the mouth of the Thames. The works, however, were only partially executed; Napoleon having changed his plans in the interim. But in 1806, when he was, once more, concentrating on the heights of Boulogne, Mr. Rennie was instructed to excavate a military canal from Hythe to Rye, encircling Romney Marsh, as that rich tract of pasture land is still inaptly styled. It was in connection with this work that Mr. Rennie came to loggerheads with the Ordnance Department. On his demanding seven guineas a day for his services it was pointed out to him that this was equivalent to

Digitized by Google

the pay of a Field Marshal. Mr. Rennie replied that he considered himself a Field Marshal in his own profession, and, as he refused to make any abatement, the claim was paid in full.

The Martello Towers—as they are called, which still decorate our coast, from Folkestone westwards, were erected at the same period, costing, it is said, £40,000 a piece. As their origin is not generally known it may be well to state that the idea was borrowed from a tower in Martello Bay, Corsica, which, with a single gun, on February 8th, 1794, beat off a combined attack by the 74-gun ship *Fortitude*, and the 32-gun frigate *Juno*. These two ships, notwithstanding their enormous superiority in guns, had to draw off after two hours and a-half steady firing; the former with the loss of 6 killed and 56 wounded, and having been set on fire. Two years afterwards, Capt. Jervis (better known as Earl St. Vincent), in a report to Admiral Young, dated H.M.S. *Victory*, Martello Bay, October 29th, 1796, wrote:—"I have the satisfaction to acquaint you that Martello Tower is reduced to a heap of fragments. Besides the advantage His Majesty's ships, will derive from the downfall of this powerful though simple fortification, I feel as if offering a sacrifice to the names of the gallant fellows who fell in the spirited attack you made upon it in the *Fortitude*." And he went on to state—what is of peculiar significance in view of his well-known antagonism to elaborate coast fortification and the prominent part he afterwards took in opposing the costly schemes of the Royal Engineers:—"Capt. Packenham is preparing a model and section of it (the Tower) to be presented to Marquis Cornwallis; and I hope to see such works erected on all the ports the Duke of Richmond proposed to fortify with citadels requiring two thousand men to defend them, and on every part of the coast likely for the enemy to make a descent on. These works will require no garrison in time of peace, and very few men, as you have experienced, when besieged and attacked by sea and by land."

In the *Century Dictionary* we find the following definite statement on the subject:—"The efficiency of this work (in Corsica) induced the British authorities to build a large number of Martello Towers on their coasts, especially opposite France, in anticipation of Napoleon's threatened invasion."

The only useful purpose ever served by these towers was affording shelter for parties of seamen employed in the coast blockade, during the years 1816–31, and subsequently for the coastguardmen.

Within two months of joining the Corps, Rice Jones was ordered to accompany General Whitelocke's unfortunate expedition to S. America, and sailed from Spithead on March 9th, 1807. The transports put in to the Canaries, where they lay for six days; but "Brigadier-General Acland ordered no officers or soldiers to go ashore." Sailing thence on April 13th, they had a long and dreary passage of more than three

Digitized by Google

months before reaching their destination. "April 30th, made the coast of Brazil in 6–30 S. Lat. By the different reckonings we were 300 miles to the eastward; should have allowed for a current to the westward of about 1 mile per hour, mean rate.

May 1st, put on an allowance of water. May 23rd. Our fresh stock being finished were obliged to live upon salt provisions for the remainder of the voyage."

Not till July 23rd did they anchor in Maldonado Harbour; having crossed the line no less than three times, *en route*. On arrival "heard of our disaster in S. America."

From the fact of there being only one entry from the day of arrival at Monte Video till the force re-embarked, on September 9th; viz.:—"Took a section of the hill of Monte Video"; one gathers that the author saw no fighting. On the date above-named he "embarked about 11 a.m., with Capt. Dickson's Company of Royal Artillery, and went out of harbour." Little did Jones—or any other of Capt. Dickson's shipmates—foresee the brilliant career in store for that young Gunner, who, in six years time, was to command the whole of the Artillery of the Peninsular Army, under Lord Wellington.

The voyage home took three months; the transports anchoring in Cork Harbour December 17th. Here he heard, for the first time, of the death of his brother James, whom he last saw at Hythe, on April 1st.

The year 1808 was spent in England, chiefly on the east coast, in concerting measures of defence against invasion.

"April 16th. Taking sections of Hollesley Bay and marshes.
May 14th. Placed pickets in Hollesley Bay.
„ 23rd. Marched with Guards to Hollesley Bay and marked out the spots for them to encamp.
Sept. 2nd. Lieut. Loyalty Peake ordered to Landguard Fort.
„ 24th. I have been constantly going round the coast of Essex, sleeping either at St. Osyth, Gt. Clacton, or Thorpe."

Early in December he received orders to be ready to embark at the shortest notice; and, on reaching London learnt that he was to proceed to Portugal.

1809. While detained at Portsmouth, waiting for the sailing of the transports, the author, ever eager to improve his mind, "went with other officers to the Dockyard to see the machinery for making blocks." The beautiful piece of mechanism here alluded to, the invention of Mr. Brunel, had only recently been installed, through the influence of Lord St. Vincent. When the invention was first brought to the notice of the Navy Board, one of the members exclaimed "What! turn a thing oval!—no, that I never can nor will believe;

Digitized by Google

turn a thing round if you like ; but as to turning a thing oval, it is only wasting our time, and so there's an end of it."

The transports were nearly a week getting to Falmouth, where, on anchoring, those on board "heard the disastrous accounts from Spain, and saw several wounded men landing," the remnants of Sir John Moore's gallant force. Three days afterwards came news "that the *Primrose*, sloop of war (one of the escorting squadron), had run upon the Manacles Rocks on Sunday morning, when we made land, and that every soul on board perished except a little boy." The body of her unfortunate captain was recovered, and buried with military honours at Falmouth.

During the detention here of the transports, from January 24th to February 22nd, Rice Jones whiled away the time in taking long walks with brother officers; his most frequent companions being Capts. Chapman and Goldfinch, of the Royal Engineers; the former, one gathers, was an artist, from the fact of his being left behind, on one occasion, at Flushing, to take a sketch. Opportunity was taken by the people around of the presence of so many young officers, to arrange various social functions, including many balls. Thus ;—"February 7th, Chapman and Goldfinch walked to the Ball at Penryn. I was prevented going by not having a good Regimental Coat here." Part of the baggage had got into a wrong transport at Portsmouth, and was not recovered until some months later. Again February 9th. "Chapman went to a Ball at Truro."—"February 16th. Walked to Penryn with the ladies who were at the ball last night." Again, "February 21st. Went to Ball at Penryn, and then walked to Falmouth,"—possibly in borrowed plumes! By way of variety Jones and Goldfinch set off on a riding tour to the Land's End, returning by St. Ives, Camborne, and Redruth.

Sailing orders having at length arrived, the transports set sail for the Peninsula on February 24th; arriving at Lisbon on March 4th, where young Jones was introduced by his commanding officer to the Commander-in-Chief, Sir J. Craddock. Two days later, he took up his billet at No. 12, Rua Largo de St. Roque. He was now appointed Adjutant to the Corps, in Portugal; bought a horse, which his landlord had procured for him, for 210 dollars; recovered his missing baggage; saw the Guards reviewed in the Rocio; and having received instructions from Capt. Chapman* to proceed along the right bank of the Tagus as far as Abrantes, and examine the ground about Thomar and Leyria, in company with Lieut. Stanway, he left Lisbon on March 21st, reaching Villa Franca the same evening—"where we were billetted on a tradesman and used very civilly." It is described as "a very neat little town in a valley, on the banks of the Tagus; the ground in the neighbourhood beautifully varied with

* See Note 2, end of chapter.

Digitized by Google

vineyards, and orange and olive groves." Later on, this beautiful spot was ruthlessly destroyed by Massena's troops. Next evening they reached Santarem where they were billetted upon a fidalgo, "who was governor of some town, but who did not treat us very well." Next night was passed at Golegao, "in a small house, but used very well." But "their cookery most disgusting." And so on, through "a beautiful country—raining the best part of the day," to Abrantes, where they were quartered upon a priest, "who used us very kindly." Next night was spent at Punhete, owing to some Portuguese soldiers, holding a post on the opposite bank of the river Zezere, refusing to allow a boat to come over for the English officers. "We were billetted in a good house belonging to an old widow lady." The historic town of Thomar—their goal, was reached next day; here they "were quartered upon a Tradesman who entertained us sumptuously." An official call was paid on the Portuguese Governor, General Miranda, who "was very polite and ordered two Engineers to accompany us round the works and the old castle, etc." Thence on to Leyria, "the weather as usual rainy. Billetted upon an old lady who behaved very kindly to us." Of course, they inspected the castle of historic fame, and next day purposed visiting the celebrated monastery of Alcobaca; "but mistaking the road, proceeded to Alcoente, where we arrived very wet and late, and were not able to procure anything to eat but bread and butter, and wine to drink." They returned to their quarters at Lisbon next day, "arriving there late and extremely wet."

Two days later, "Lt.-Col. Fletcher, Capt. Burgoyne, and Lts. Hamilton, Boothby, and Mulcaster landed here, and dined with us." The names of the first two officers will be familiar enough to students of the Peninsula Campaigns. Capt. Charles Boothby, a young Engineer officer of high promise, had the misfortune to lose his leg and his liberty at the Battle of Talavera, six months after landing, and remained a prisoner-of-war, in France, till July, 1810. His career as a soldier having been thus cut short, Boothby took Holy Orders, and was presented to the Crown living of Sutterton, in Lincolnshire, where he died in 1846. The story of his brief military career has been told by himself, in a book entitled *A Prisoner of France* (Adam and Charles Black, 1898).

TO HIS FATHER.

ADDRESSED TO:—
CAPT. R. JONES,
ROYAL DENBIGH MILITIA,
CHATHAM.

LISBON, *March* 5, 1809.

MY DEAR FATHER,

Yesterday morning we anchored safe off this place after a very pleasant voyage (if it is possible to call a voyage pleasant) we had good weather

Digitized by Google

and fair wind most of the way, and it is reported that we had a narrow and fortunate escape from the French fleet, which they say here is now at sea; for all this I am very thankful and trust you are all well in England and Wales.

We sailed on the 22nd ult. and upon our getting out of the harbour of Falmouth we were taken under Convoy of the *Lavinia* Frigate, Capt. Lord Wm. Stuart, who was laying to for us, with a fleet of 19 sail from Plymouth consisting of merchantships, and transports with Artillery on board. As soon as we anchored Capt. Chapman and myself went ashore and waited upon the Commander-in-Chief, Sir John Craddock. Capt. Chapman has told me that if I like it, it was his wish that I should remain here with him; he is extremely kind and attentive to me, and I believe he intends taking me with him in whatever house he may be billetted. Our officers are billetted upon the inhabitants of this city, and have excellent rooms and accommodations; we get our quarters to-morrow. The British troops are all in this city and environs; they have lately been in constant readiness to embark; but no one seems to know where the French are, or whether this place is to be defended or not; since the arrival of General Beresford and ourselves, they seem to be rather more determined to defend it.

I fear we shall have some difficulty in mounting ourselves here, horses being not only dear but scarce; I am fearful I shall be obliged to draw upon you or Mr. R. Jones once more, as soon as I can find a decent beast, but make no doubt if we remain here I shall soon be able to remit it to you again. We are each allowed forage for three horses and a mule, and are to embark one horse each in case of this place being evacuated.

This is the most beautifully situated place I ever saw; the River Tagus is very fine all the way up. We have just walked to an immense Aqueduct near here, and have been regaling ourselves in a Vineyard and Orange Grove; the Vines are not yet in bud, but the oranges are excellent. The weather is as warm as the summer in England, and everything is in Blossom or bearing fruit. In my next I will give you a longer account, and will now conclude this by desiring my best love to my dear Mother and John, Mary, Anna, Eliza, Ebenezer, and Margaret.

Your loving son,
RICE JONES.

We have seen nothing of our baggage yet and begin to want it very much. Direct to me, "With the British Army in Portugal, Lisbon."—R.J.

LETTERS TO HIS FATHER.

LISBON, *March* 17, 1809.

MY DEAR FATHER,

On the 5th inst. I acquainted you with my safe arrival at this place, and have now the pleasure to inform you that I still continue in very good health. I am billetted in the Rua de San Roque, one of the pleasantest parts of the city; the house belongs to a Portuguese merchant named Don Bernade Silde; he is very civil to me; I have two rooms besides my bedroom and my servant's; I am the only officer that has ever been

Digitized by Google

quartered upon him and he wanted to feed me at first, but I would not let him.° I find the little knowledge I have of Spanish of the greatest use to me, as it enables me (with the addition of what Portuguese I learn) to make myself understood in general.

This is a most delightful country at this time of the year; it is warm but not uncomfortably, and every thing is green, in blossom or bearing fruit.

The British troops have returned from Cadiz in consequence of the refusal at that place to admit them; they have disembarked at this place and environs; of course the detachment of our Corps destined for Cadiz has rejoined us.

You will I daresay be surprised to hear that I am once more doing the duty of Adjutant; in consequence of the great strength of our Corps here, and our having eight R.M. artificers, Capt. Chapman has appointed me to act as Adjutant to the Corps in Portugal, and has written to General Morse acquainting him with it and begging his approbation of the appointment. I am not very sanguine in my expectations of receiving the allowance for it; but I am glad of the situation inasmuch as my being chosen is flattering to myself, and also, it will keep me about Head Quarters with the Commanding Royal Engineer. There are 10 Engineers in this place at present, ... Capt. Chapman is ordered by Sir John Craddock to proceed into the interior to the neighbourhood of Thomar, Santarem, Abrantes, etc., to examine and report upon the ground there, as a position for an army intended to cover the approaches to Lisbon; he will set off to-day or to-morrow and I expect I shall accompany him with a detachment of our officers here; how long we shall be gone it is impossible to say; it is not improbable the army may soon follow us; at present they occupy a position at Lumiare, about 6 miles from here; it is a very good one, but is too near Lisbon to cover it effectually.

I have not yet been able to get a horse; it is however absolutely necessary before I can move from Lisbon; they are extremely dear and scarce. Capt. Chapman gave 50 guineas for one yesterday; it is hardly possible to get them for money; the French took most, and our army some; with the remainder every one is joining the Portuguese Army, for here every one is in arms. Capt. Chapman has represented this, as well as our want of allowance for servants, in the strongest manner to the Board; I wish it may have a good effect.

Please to give my best love to my dear Mother and my dear brothers and sisters. I am in hopes of soon hearing of your continued good health. Direct to me, "With the British Army in Portugal, Lisbon."

Your very loving son,
RICE JONES.

LISBON, *April* 5, 1809.

MY DEAR FATHER,

Since my last letter I have been reconnoitring the interior of this country.† I went from hence to Santarem, Abrantes, Thomar, Leyria,

° See Note 1, end of chapter.
† See Note 2.

Digitized by Google

etc., making a circuit of about 270 miles, and am now busy making out a Report upon the ground I passed; Lt. Stanway, a very young officer of ours, accompanied me; Capt. Chapman being obliged to remain in this place where we are commencing batteries on both sides of the Tagus; the Portuguese Engineers will I believe have the execution of those nearest Lisbon. It unfortunately rained every day I was absent from this place; but I am extremely glad I went, as in the event of our being obliged to evacuate this country, I may not have another opportunity of seeing it. We were billetted on the natives of every place we went to, and were in general very kindly treated, being the only English officers they had seen for some time; they were very anxious for the arrival of our troops, and received us with huzzas, etc., expecting that we were advanced and that the others were to follow us. It unluckily happened to be *Lent* all the time, consequently no one had anything to eat but fish; our food was regularly a fowl stewed in rice, and very oily. I could not bring my taste to like their dishes, but was unable to procure anything else: to complete our dislike we were always entertained soon after our arrival at any house, with the cries of the dying cock. I waited upon the Portuguese General Miranda at Thomar, who received me very kindly, showed me all the reports of his Quar.-Masr.-Genl. had upon the Position in that neighbourhood, and sent a Capt. and Subn. of Engineers to show me the batteries they were constructing. Every one in the country was armed, principally with Pikes; but after the termination of the boasted defence of Oporto, I am very dubious of their fighting. From our uniform being like the French we were sometimes mistaken for officers of that nation. A Portuguese outpost that had charge of a ferry boat across the river Zezere refused to come over for us, for all we could say or do, and we were obliged to go a great deal out of our way, to a bridge of boats. At every village we were desired by a guard of the natives armed with Pikes to show our Passports, but I seldom indulged them with a sight of it, and they never objected to our proceeding.

On my return I had the pleasure of finding a letter from you, and was happy to hear you are all well. I continue very well and have experienced no inconvenience, thank God, from the repeated wettings I had on my tour.

On Sunday Lt.-Col. Fletcher, Capt. Burgoyne and Lts. Hamilton, Boothby and Mulcaster arrived here from England, which is a very unfortunate circumstance, both to Capt. Chapman and myself, as he loses his Command and pay for it, and I lose the Adjutancy, Lt. Mulcaster having been appointed Adjt. and Qur.-Mr. before he left England. I am certainly extremely unlucky; I shall lose by these officers' arrival three shillings a day.

Our baggage is at length arrived here; it was brought from Falmouth by a Merchant Schooner; I shall take care to profit by the lesson I have had and not part with my baggage so easily again.

Previous to my late journey I was of course obliged to purchase a horse, but he cost about double his real worth, owing to the great scarcity of horses; he is very strong, 7 years old and sound, but I cannot

Digitized by Google

say much in favour of his beauty: he carried me remarkably well all the way. I gave 210 dollars (at 4s. 6d.) for him. The Ordnance Commissary has advanced me the money I wanted, so that I have not been under the necessity, I feared I should have been, to trouble you again. If we remain in this country I shall be able to clear my account soon, if not, I can but trouble you at the last.

All the troops are out of this city except the 87th, part of the Artillery and ourselves. The Head Qrs. is at Lumiar 6 miles off; but Sir J. Craddock has generally resided here, as yet. There are a good many reports current respecting the force in which the French are approaching us. Oporto is certainly fallen into their hands, and they are 6 leagues this side of it; other columns are, it is said, coming by other routes, so that it is very dubious whether we shall stand their attack or not. Our force is given out here to be 16,000 or 17,000 men, but I have good authority that it does not exceed 12,000: if so, I am of opinion we shall embark and leave the French in quiet possession of Lisbon, for I fear we can place but little reliance on the Portuguese fighting.

At the time I was detached up the country Capt. Goldfinch and Lt. Alex. Thomson were ordered to Oporto.[o] We have heard from Goldfinch, who said the French were very near, and the best hope he had was that of being exchanged soon, when taken. We have heard nothing of him and fear he is either Killed or taken prisoner, but hope it may be otherwise. Had I not been Adjt. I believe I should have gone there too.

Please to give my best love to my dear Mother and all my dear Brothers and sisters, John, Mary, Anna, Ebenezer, Eliza and Margaret. Write me all the news as soon as you can.

Your very loving son,
RICE JONES.

NOTE 1.

This was no solitary experience: nearly every British officer who has penned his reminiscences of the war bears testimony to the courtesy and kindness of the Portuguese. "On entering a town or village," writes the author of *Letters from Portugal and Spain*, "we received from the magistrates billets on the best and richest inhabitants; and they were obliged not only to admit us, but to furnish us with lodgings for our whole suite. And to do them justice, we have been treated with the courtesy of visitants; their politeness never allowed us to remember that our quarters had been yielded to a command." Near Coimbra—next to Lisbon, the principal hospital station for the sick and wounded of the British Army, during the war—was a fine Quinta belonging to the Condeça d'A——, where British officers of all ranks were admitted, and received the tenderest care. The wife of a diplomatist, in her interesting *Letters from Lisbon*, penned soon after the war, writes, "How much reason have many of the English to remember the genuine friendship of this family! I am assured by eye-witnesses that during the war the princely

[o] Both these young officers were made prisoners by the French on their capture of Oporto, but subsequently effected their escape.

Digitized by Google

mansion was ever open to our wounded officers; so much so that the house resembled a hospital, and the lives of several individuals were preserved entirely through the kind and unremitting attention which they received from their really illustrious and excellent hosts." Mark what follows. "I ought not to omit that their example was followed in a more humble way by the peasantry, during the time of that great struggle; and after this proof of just and grateful feeling, who ought to believe that the Portuguese are incapable of moral regeneration? And yet I hear this asserted every day of my life."

It is, alas! too true that the conduct of the Portuguese Government and many of its incompetent officials during the war, have blinded our eyes to the fine qualities of the Portuguese people, and to the noble conduct of private individuals—the numerous acts of kindness, self-sacrifice and tender sympathy which did so much to alleviate the sufferings of our sick and wounded . . . Even Napier has never allowed one word of acknowledgment of all this to slip from his facile and eloquent pen.

Note 2.

Instructions for Officers of the Corps of Royal Engineers when attached to Columns, or moving through the Country.

The Engineer when moving with a column or otherwise will observe the general features of the country through which they pass, whether hilly, level, woody, open, or enclosed, the state and breadth of the roads, whether they are practicable for artillery, their bearings by Compass, and the Passes and positions in the route. Such parts of the country as may be sufficiently open and level to enable cavalry to act with advantage should be remarked. The Rivers should be particularly attended to, their breadth and depth at the time and place of passing them, and (as far as can be ascertained by enquiry) their state at other seasons of the year should be noted. The bridges, whether of wood or stone, their length and breadth and whether capable of bearing Artillery, or if they could easily be made so should be mentioned. An opinion should be formed of the population of the towns and villages, their distances from each other, and their means of supplying cantonments, provisions, water, and fuel. The situations favourable for encampments should be observed, and whether water, fuel, and materials for hutting are near them. The probability of obtaining mules or draft oxen and carts on the road, should be considered as intimately connected with the movements of troops in this country. In general, whatever can facilitate or retard the march of an army must be carefully attended to, and the whole digested into a written report, accompanied by such sketches as circumstances may admit of. Whenever the army or a column takes a position, the Engineer will make a sketch of the ground upon a scale of 3 in. to a mile, accompanied by explanatory references. Upon arriving at any fortifications or military work, a sketch must be made in the most accurate manner, and in the largest scale the means of the officer will allow, both as to plan and section, accompanied by a general report. They will upon a smaller

Digitized by Google

scale sketch the ground within about 2,000 yards of the place, and will particularly observe if the work be commanded within 1,000 or 1,200 yards of the place, and by references will distinguish such hills as are higher than the place, and how much they appear to be so; the number of troops necessary to defend such work; the extent of the accommodations and the proportions of it that may be bombproof, the number, size, and construction of the magazines, the supply of water, and the number and nature of the artillery will fall within the report to be made on each work. The nature of the soil, whether favourable or otherwise for sinking trenches and throwing up batteries will naturally be attended to.

(*Extract from Official Papers, in Rice Jones' handwriting*).

(*To be continued*).

Digitized by Google

PASLEY'S "ESSAY ON THE MILITARY POLICY OF THE BRITISH EMPIRE."

CONTEMPORARY CRITICISMS, 1810—1813.

By COLONEL B. R. WARD, R.E.

IN an article published in the May number of *The R.E. Journal* a short extract was made from the above Essay, and a few criticisms were quoted showing the impression made on the mind of the country by its publication in November, 1810, and by the three subsequent editions published in 1811 and 1812.

Sir William Napier rounds off his *History of the Peninsular War* with the following striking sentence :—

"Thus the war ended, and with it all recollection of the veterans' services."

An exactly similar fate has overtaken the work of Sir Charles Pasley. The services of the writer who first impressed on the national imagination the extraordinary valour of British soldiers, and by so doing encouraged the nation to adopt a vigorous and consequently successful military policy, have been forgotten as completely—nay, far more completely—than the services of the veterans of Albuera, of Badajoz, and of San Sebastian. At the present moment I happen to have access to the following works of reference, the *Encyclopædia Britannica* (9th edition) and *Chambers' Encyclopædia*.

In the Index to the former work the following are two consecutive entries, Paskewitch and Paso Robles. Paskewitch was an officer who served in the Russian Army against Napoleon at Austerlitz and Borodino. Paso Robles is the site of a hot spring boasting a temperature of 122° Fahrenheit in Obispo County, California. *Chambers' Encyclopædia* is equally innocent of any reference to Charles Pasley.

The Corps of Royal Engineers is, however, during the present month doing something to remedy this neglect of Pasley, by the celebration of the Centenary of his foundation of the School of Military Engineering at Chatham.

Of all the things that Pasley did during his long and strenuous life —the publication of the Essay, the foundation and organization of the R.E. Establishment at Chatham, and the discovery of Portland cement—probably the first named will be considered not only first in order of time, but also first in order of national importance.

Digitized by Google

It may therefore be interesting at the present time, while we are doing honour to Pasley as the founder of the S.M.E., to supplement some of the criticisms quoted in the May number of the *Journal*, by quotations from other contemporary letters and journals which may help us to realize not only the impression produced at the time but also the permanent value of Pasley's Essay.

Pasley himself seems to have recognized that the Essay possessed a permanent value beyond the temporary effect which it produced on the national policy between 1810 and 1815, for he intended many years afterwards to re-issue the 4th edition. The following entry occurs in his diary opposite the date 28th December, 1848 :—"After a great deal of trouble found my proposed Preface of the 4th edition re-issued of the *Military Policy*, and begin writing at it again."

The following letter to his publisher dated London, 21st April, 1849, shows that the re-issue of the 4th edition was temporarily dropped :—

"SIR,

I enclose as much as will make a sheet of the Introduction and Observations to the 4th edition, *Military Policy*, re-issued. It appears to me that it will be best after you print certain sheets of this to drop it for the time being and go on with the 2nd edition of the *Elementary Fortification* which is most in demand.

C. PASLEY."

Nothing further can be traced in his diary as to the re-issue of the 4th edition; and an enquiry at the British Museum shows that they possess no later edition of the book than that of November, 1812.

A single copy of a portion of the Preface of 1849 now in the possession of Sir Charles Pasley's grand-daughter, Miss Tyler, of Linden House, Highgate Road, N.W., would appear to be the only remaining fragment of the book. Although Sir Charles Pasley's intention of republishing remained unfulfilled during his lifetime, the question of its re-publication in our own time would certainly appear to be a matter for serious consideration.

The permanent value of Pasley's work consists in the soundness of the principles which he uses as a basis on which to construct a suitable national policy.

The time was one of crisis and convulsion, and few will deny that the same description is somewhat applicable to the year of grace 1912. No less than our forefathers a hundred years ago do we require to be reminded of those permanent principles underlying politics and war, which, although constantly being lost sight of, cannot be deviated from without running the risk of national ruin.

The following letter from Sir John Stoddard, editor of *The Times*, dated 1st September, 1811, emphasizes the point as to the principles of the Essay :—

Digitized by Google

"My Dear Pasley,

I would long since have acknowledged with great satisfaction the present of your second edition, but I wished not to write without saying something about the work itself; and I have not found myself at leisure till to-day to make the attempt. As you have added little or nothing but the notes which are not many in number, this edition can produce little change in my ideas of your production. I have however had time to weigh the whole very deliberately, and in proportion as I consider it of national importance, do I feel it desirable that a more complete development of its principles should at some time take place. You have doubtless had the critique in the *Quarterly* and I perceive you are to expect one in the *British Review*, which is to be published to-morrow. The *Quarterly* I understand to be written by Southey and I think it calculated to do the book good. It does not however speak of its general merits in higher terms than I have heard directly and indirectly from many persons of weight who are total strangers to you. Sir William Scott in a large party said it was the most original work he had met with for a long time. . . . I was told also of Sir Hugh Dalrymple's speaking very highly of the book, and no doubt you must have had many testimonies of approbation from military judges, but a man like you will not be satisfied with mere popularity; you will wish to render your work perfectly sound and unassailable in point of principle, in the first place; and secondly to apply these principles as extensively as possible to the actual and probable circumstances of the country. I know but four whose views appear to me comprehensive and important—yourself, Walsh, Wordsworth, and Coleridge: and though in many points you may all differ, yet in the main your principles may be found more consistent than they first appear. I do not add Leckie, for although he is shrewd and fearless in his speculations and rests on some very strong facts, he seems to me very weak and confused in principles, and a stranger to the true English spirit which is allied to a zeal in the general cause of humanity. We live in times of crisis and convulsion and it is at such times that a steady adherence to the soundest principle is peculiarly important."

The Times had previously criticized the 1st edition of the Essay in its issue of the 11th February, 1811, when it devoted three columns to quotations from the book, introducing the subject as follows:—

"Capt. Pasley's *Essay on the Military Policy of the British Empire.*

We take the liberty, without further preface, of introducing a pamphlet with the above title to the knowledge of our readers, though the author of it is entirely unknown to us. The work has, we learn, excited greater attention among the higher classes of political readers in the country than any since the time of *Mr. Burke*, without even excepting Mr. Walsh's celebrated performance on the affairs of France. The author's general object will be best understood by the following extracts from his introductory chapters."

The next day *The Times* devoted more than two columns again to the same work, introducing the further extracts as follows:—

Digitized by Google

"We can do little more at present than continue our extracts from this valuable publication, taking care to select them from those parts which relate to subjects more generally interesting. The following relate to the Peninsula of Spain and Portugal, countries upon which British feelings have not yet ceased to be alive."

The *Edinburgh Register* inserted at about the same time the following reference to the Essay :—

"Capt. Pasley of the Engineers was severely wounded on this occasion, (*i.e.* during the Walcheren Expedition) a man who in his Essay upon our Military Policy has enforced truths of such practical importance that his individual loss would have been a greater evil to his country than the possession of Walcheren could have counterbalanced."

The *British Review* of September, 1811, devoted Article VIII., containing 38 pages, to the Essay.

After making some general remarks on the necessity for a more hopeful national outlook, and on the need for courage, perseverance and patience, the reviewer proceeds :—

"These preliminary observations bring us at once to Capt. Pasley's work, an attentive perusal of which has, in fact, in a great measure suggested them. It is only strict justice to the author to say, that we recollect no modern publication, of the same description and character, at all comparable to it. The style is throughout easy, unaffected and perspicuous; the reasoning close and logical; the sentiments elevated and original; and it has the rare merit of being unsullied by any feature of party spirit. The author is well versed both in ancient and modern history; and draws from the abundant stores, with which such reading has furnished his mind, reflections generally accurate as referable to the present state of Great Britain, and often pointed with peculiar propriety and facility of application. He frequently reminds us of Polybius by the profundity of his observations, though he bears no resemblance to him in point of prolixity. The arguments and suggestions are throughout traced from principles not presumptuously or dogmatically laid down, but founded upon the experience of past times, and established by a judicious reference of effects to their proper causes.

In composition he aims at nothing beyond his powers; and there is every internal testimony that his labours were instigated by the single and honourable motive of rendering service to his country, whose dangers he has correctly estimated, and whose capacity for exertion on a larger scale he has ably developed and vindicated.

It is fortunate, we will not say surprising, that a military man could be found, who from tone of mind, education, extensive reading, observation, and habits of reflection, was qualified to engage in a book of this nature, as no one but a military man could have properly undertaken it. This observation applies also to the Roman historian before adverted to. In his works we think the soldier predominates, and the reverse in that of Capt. Pasley, who though an officer of established reputation, refers to recent expeditions and campaigns only with a view to illustrate his principles or to point out defects which he proposes to remedy; but he

Digitized by Google

is never betrayed into details, which would have exhibited his knowledge, and science, without strengthening his argument. He was not writing a military history; but was engaged in the far more important task of pointing out to his country the means of present safety and of future glory. Capt. Pasley's principal object seems to be—to rouse the nation and its rulers, whoever they may be, to a just sense of our military means, with a view both to offensive and defensive war, and to point out the danger of neglecting them;—to show the folly and hazard of an exclusive reliance on our naval superiority;—to prove that systems are better than expedients;—to point out the absurdity of coalitions, as usually formed;—to maintain that our principal reliance should be on our strength, properly called forth and applied; that we should pursue one object at a time, taking Roman Policy for our model in this respect;—to ridicule a purely defensive system,—to condemn generally speaking insular conquests;—and to reprobate the practice of hastily abandoning conquests of any sort when once made.

In frequently enforcing these several topics, he supports his respective propositions by ample and able references to ancient and modern history, as illustrations of them; and is copious in his remarks on some recent transactions particularly those connected with the Peninsula and Sicily. From a frank avowal of his political principles he never shrinks. The point which he most strenuously urges, with a degree of enthusiasm, which we cannot but admire, is the capacity of Great Britain to face Bonaparte successfully, on what has been vulgarly considered to be his own element; and the duty which she owes to herself and to Europe, and to the world, to enter into the contest with vigour, undertaking to show that by pursuing such a course she has in her own hands the means of delivering the Continent from its state of thraldom, and to secure for herself the proud station of pre-eminence amongst the nations of the world."

The following private letter from Lord Oxford to Pasley may be quoted not only as showing his appreciation of the value of the Essay to the Directing Classes of the country, but also because of the valuable suggestion made in it that the next edition should contain an index. A re-arrangement of the chapters as originally written and a full and complete index would be very desirable, should a new edition of Pasley's Essay ever be brought out:—

"37, Upper Brook Street, *Friday Morning.*

When people have a mind to put an author into good humour with himself, I observe that they are fully as attentive to the soundness of their own periods, as they are to dwell on the merits of the work, and think they cannot pass an eulogy, without showing their own powers of composition. I neither can nor will do this but with plain sincerity tell you how very much I was pleased with your *Military Policy*, and what is of greater importance it has obtained the approbation of honest and sensible men in the higher classes of society—some of whom, although they have hitherto slumbered over the Art of War, yet have abilities and courage too, to save the country, if they were not overwhelmed with the weight and number of corruptions. You are aware possibly that one

Digitized by Google

edition has been sold, another is loudly called for, as well as the second part of the work which I trust is in great forwardness. Give me leave however to suggest an alteration, or more properly speaking an addition to another copy. Your book is valuable itself, and is one of reference, and for us fine ladies and gentlemen who can snatch but little time from pleasure and dissipation, a very complete index is necessary in order to discuss the Art of War in all its several branches, more especially in a sinking State. Many an opportunity have I lost of showing my own genius, from not having time to rummage through your book after a particular passage, in order to illustrate my meaning and to illuminate my audience. I have therefore for my own private advantage made out an imperfect sketch of the kind of index that is wanting, which could easily be enlarged in the manner of the index in Gibbon's *Decline and Fall.*"

The following four extracts are from the letters of Robert Southey. They were written while he was engaged in reviewing the Essay in *The Quarterly Review* :—

"(i.). *To Walter Savage Landor, Esquire.*

KESWICK, *11th January*, 1811.

Have you read Capt. Pasley's book? I take it for my text in the next *Quarterly*, and would fain make it our political Bible.

(ii.). *To Mr. Ebenezer Elliott (afterwards known as the Corn-Law Rhymer).*

KESWICK, *7th February*, 1811.

If ever you think on political subjects, I beseech you read Capt. Pasley's *Essay on Military Policy*, a book which ought to be not only in the hands but in the heart of every Englishman.

(iii.). *To Grosvenor Bedford, Esquire.*

KESWICK, *16th February*, 1811.

I am reviewing Pasley's book. The most important political work that ever appeared in any country. The minister who shall first become a believer in that book will obtain a higher reputation than ever statesman did before him. My review will be conciliatory towards the husbanding politicians, that is it will endeavour to make them ashamed without making them angry.

(iv.). *To Walter Scott, Esquire.*

KESWICK, *2nd April*, 1811.

No doubt you have seen Pasley's Essay. It will be in the main a book after your own heart. He talks sometimes of conquest when he should talk of emancipation. A system of unlimited conquest leads at last to the consequences which we have seen exemplified in the fate of the Roman Empire. For ourselves I would wish no other accession of Dominion than Danish Zealand and Holland, with as many Islands as you please in the Mediterranean; Italy to be formed into one independent State under our protection as long as it needed it. I believe that the Ministry do not want inclination to act vigorously; but they want public opinion to go before and protect them against the Opposition. These men and their coadjutors, the *Morning Chronicle* and the *Edinburgh Review*, have neither patriotism, nor principle, nor feeling, nor shame to stand in their way. They go on predicting the total conquest of the Peninsula, with as much

Digitized by Google

effrontery as if they had not predicted it two years ago—nay even asserted that it was even then completed;—and they deliver their prediction in such a way, that it requires more charity than I possess not to believe that they wish to see them fulfilled; for this is the last and worst, yet the necessary effect of party spirit when carried so far as these politicians carry it."

In the May number of the *R.E. Journal* Southey's criticism in *The Quarterly Review* was quoted from, and the enthusiastic reception of the book in the Army was alluded to. We may close our contemporary references to the Essay by quoting from the private correspondence of two writers of the period. The first is the well-known novelist, Jane Austen, and the other is Mr. G. T. Leckie, the author of *Sketches of Intrinsic Strength, Military and Naval Power of France and Russia, 1808.* It has sometimes been considered a matter of surprise that although Jane Austen's novels from *Northanger Abbey*, written in 1798 to "Emma," published in 1816, cover the last and most dramatic period of the Revolutionary and Napoleonic Wars, there is no indication in any of the books that the calm and even tenor of her way was ever in the slightest degree disturbed by the stupendous political events occurring in Europe. And yet her two youngest brothers, Francis and Charles, were sailors, and served in the great war, each rising to the rank of Admiral.

The following letter is interesting as showing that, although it does not come out in the novels, Jane Austen was not without a genuine interest in large questions of national policy.

It has been said that Napoleon's policy failed largely because he underestimated the power and importance of the feminine element in the world, and took little or no trouble to enlist its sympathies in favour of what he used to speak of as "ma politique." Jane Austen's letter is interesting in this connection, as it shows that the principles of policy laid down by Pasley, inspired as they were by Nelson, could and did, in the case of at least one well-known personality, appeal to contemporary feminine sentiment.

The letter was written in February, 1813, to her sister Cassandra, and a short extract from it runs as follows:—"I am reading a Society Octavo, an *Essay on the Military Policy of the British Empire*, by Capt. Pasley of the Engineers, a book which I protested against at first, but which upon trial I find delightfully written and highly entertaining. I am so much in love with the author as ever I was with Clarkson and Buchanan, or even the two Mr. Smiths of the City. The first soldier I ever sighed for, but he does write with extraordinary force and spirit."

The following are extracts from letters written by Mr. G. T. Leckie to Capt. Pasley between February and July, 1811:—

"I dined the other day with Mr. Hope of Harley Street. He thanked me again for having put your book into his hands and told me he had

Digitized by Google

sold about 30 copies for you, as he had made it a point with all friends that they should procure it. . . .

Your friend Riley Addington got it at my desire; he is so enchanted with it he told me he should not leave it till he had given it a third perusal; he says you are a philosopher, a statesman, and a soldier in every sense of the word, and he seems much reconciled to *our* view of political justice which you have developed in so masterly a style."

The following letter is dated March 27th :—

"I am sorry to be disappointed in the hope of having you here, not because it would alleviate me in correcting your new edition, for that I will do with great pleasure and as well as I am able . . . Independent of the principles which are congenial to our own, and the only ones suitable to the conduct of a great empire established and maintained by the sword, I much admire its conciseness, with that perspicuity at the same time, which, in my mind makes it approach nearer to the Grecian model of composition than any modern work I have met with. Nothing is wanting to give a clear bird's-eye view of the politics of Sweden, and when one has read this little book, and feels conscious of the mass of ideas he has acquired, he is astonished how the writer could get it into so small a space without disorder. Xenophon would probably have arranged it in the same manner, and I feel much obliged to you for the book, which I value highly. I have recommended it to all my friends, but that is unnecessary for it sells very fast."

The following letter was written in June or July :—

"I dined yesterday with Clinton. There was nobody there but Lord William Bentick. He is charmed with your book. He said it ought to be called the Soldier's Bible and the Gospel for Statesmen."

Lord William Bentick had commanded a brigade under Sir John Moore at Corunna, and afterwards held a divisional command under Lord Wellington in the Peninsula. Shortly after his meeting with Leckie in July, 1811, he was appointed British Minister to the Court of Sicily and Commander-in-Chief of the British Forces in that island. He was appointed Viceroy of India in 1827, his period of rule in India being best remembered by the abolition of Suttee.

His opinion as to Pasley's Essay being "The Soldier's Bible and the Gospel for Statesmen" may be taken as a concise and typical utterance of the best public men of the time as to the value of Pasley's work. The principles laid down by Pasley are no less true and hardly less important to-day than they were in 1810, and it is to be hoped therefore that a new edition of the Essay may be published ere long so that the present generation of soldiers and statesmen may have an opportunity of again studying a work which had so great an influence a hundred years ago.

Digitized by Google

A LADY'S EXPERIENCES IN THE GREAT SIEGE OF GIBRALTAR (1779–83).

BEING THE DIARY FROM 1ST JUNE, 1779, TO 13TH JUNE, 1781, OF MRS. GREEN, THE WIFE OF LIEUT.-COLONEL GREEN, CHIEF ENGINEER OF GIBRALTAR (AFTERWARDS LIEUT.-GENERAL SIR WILLIAM GREEN, BART., CHIEF ENGINEER OF GREAT BRITAIN, 1786—1802). EDITED BY COLONEL E. R. KENYON, R.E.

(*Concluded*).

JANUARY THE FIRST 1781.

Monday. Easterly Wind. No sort of Notice taken of this Day upon the Parade—or in any other respect—by the Governor. It was a Cold, Unpleasant Morning, and continued an Uncomfortable Day in all Respects. We had a party at dinner but by no means either cheerful or Easy, as might have been wish'd. The Enemy are not busy to Day. This Day Some Spainish Letters and papers which were found on board the Setee which our Men of Wars Boats brought in on last fryday were brought to the Governor, to our House. I saw several but they gave no very Material account,—mostly seem'd private family Letters; except a Couple which were wrote it should appear by good Judges of our, as well as of their own New Works; but those letters were not Sign'd. There were also some Beads and a Crucifix and other articles belonging to a Priest who had been too much hurried in geting away. There is likewise Some Caps and a few things belonging to a Lady as we suppose, but that is only Conjecture as every Person had quited the Setee, nor was there any Live Creature left but one Pig. These things are all in Captn Leslie's posession. He talks of sending back the Lady's Caps &c and the Letters except those two above mention'd, but I do think the Govr will hardly Yield to Him. It would be highly improper to send any Letters back; that would hurt the People who wrote them. 1st January, 1781.

Tuesd 2. Easterly Wind. A much finer Day than yesterday. A Man of the 72nd Regt Deserted last Night from Bay Side Guard. The Man of the 39th has not been heard of. It is supposed He has either got clear off or has met with the fate of some others who have Dash'd to pieces in trying to get off. Very little firing from Us upon the Enemy. The Col at Captn Loyds whist Party this Evening.

Wed· 3. Easterly wind and very Cold Raw Day. An experiment was try'd today, viz., a New Invention for proving, or rather trying of Cannon, upon the Kings Bastion, Under the Direction of Lt Fredrick

Digitized by Google

3rd January, 1781. of the 72nd (Son to Sir Charles Fredrick, Surveyor Genl of the Office of Ordnance). It gave much Satisfaction to every Body ; the Govr also seem'd Well pleased ! ! !

Thursd 4. Easterly Wind. A Cold Raw Day. All quiet from the Enemy. Find myself exceedingly indisposed, but being under an Engagement to Sup out I was obliged to keep up as much as possible ; and in Consequence I went out to Mrs Fancourts. Very little firing. Auctions every Day. Some times the Several Articles Sold pretty well. The English Rounds of Beef are very good ; but are got up to an amazing price, viz., 7 Rials pr lb equal to 3 shillings.

Fry 5. Easterly Wind. Clear Cold Day. Colonel Ross gives a Dinner to the whole of the officers of the 72nd Regt, Supposing himself the Colonel of that Regt.* It consisted of a very Large Number, 43. All Ended with great Harmony, they sat late. Many People Wonder that the Colonel should take a step of this kind till He was quite Confirm'd in his having got the Regt. He is now in very high spirits and seems to have forgot all past Circumstances. We do not Fire now but little, except when any thing in particular is doing.

Saturd 6. Easterly Wind, fine Day. Moving powder from the South into the Town Magazines and the Castle. The Enemy have been throwing up a great deal of Sand and carrying on their Boyau toward Fort Barbara. This Even the following was in Garrison after Orders :—"The Morning Divine Service to be in the Convent Court to Morrow and on the first Sunday of every following Month."

Sund 7. Easterly Wind. Cold Day. Col up very Early to go to the Southward with the Govr. Things not very agreable, either publickly or privately. Col Din'd out at Col Craigs.

Mond 8. Easterly Wind ; Cold and Unpleasant. A most Uncomfortable Day, and Much discontent in Garrison. The American club Day.

Tuesd 9. Easterly Wind, fine Day. Am taking very ill, with pains in my Limbs and in great Uneasiness in all Respects. The whist Meeting at Captn Hastings.

Wed 10. Easterly Wind and Raining Hard. This, and every Morning of late, We have been trying Experiments by firing from the Old Mole towards the New Work, sometimes with good Success. I am exceedingly ill at this time. Colonel also indisposed. Mr Booth taken ill.

Thursd 11. Easterly Wind. Early this Morning two Moorish Vessels that have been at the Orange Grove for more than 12 Days and which We could not tell what to make of, came to the Mole under protection of a Flagg of Truce, and were received by a Flagg of Truce from Us. They are come from Barbary and bring over all the Christians that were sent from this Garrison some Months agoe, by

* See December 23rd, 1780.

Digitized by Google

order of the Emperor, beginning with the English Consul and Mr Butlers family &c &c. The Emperor would not allow any of Them or the English Consul to remain in any Part of Barbary. Mr Butler the Dutch Consul who left this Garrison 16 Months agoe is also come away. They were not allowed to bring any thing with them except their Cloaths, and had only 5 hours Notice. 11th January, 1781.

Fry 12. Easterly Wind. Very Severe Cold Weather, and find myself greatly indisposed. The Colonel much distress'd about Mr Booth, and other very Uncomfortable Circumstances. Do not hear that the People from Barbary bring over any News. Some Coals which came in the late Vessels from England are sold upon the Parade for a Hundred Dollars a Chaldron. They are bought by Government.

Saturd 13. Easterly Wind. Raw Cold Day. I have not been down stairs since Tuesday last, nor do I think I shall for some time to come. The Colonel also much indisposed. It is Still Reported that the Enemy have got Mortars into the New Battery. N.B. By a Spainish Gazette which the Consul got whilst the Vessels lay at the Orange Grove We find the Enemy have given the Name of St. Carlos to the New Battery, it is Supposed in Honor of their King.

This Day the Regulations for Officers Provisions from the 15th Janry to the 11th Febry 1781.

Officers pr Month. 28 lb of Bread ; 4 lb of Beef ; 4 Do of Pork ; 10 oz of Butter ; 1½ lb of Cheese (in lieu of 2 lb of Beef) ; 4 pints of Kidney Beans, or Carravances ; 4 pints of Wheat ; 3 lb of Flour ; 2 lb of Raisons.

The Wheat, Kidney Beans, Raisons, and Flour are in lieu of 12 pints of Pease and 30 oz of Butter.

4 lb of Beef and 12 pints of Oatmeal to be paid for.

Men pr Week. 7 lb of Bread ; 1 lb of Beef ; 1 lb of Pork ; 1 pint of peas ; 2½ oz of Butter ; 6 oz of cheese (in lieu of ½ lb of Beef) ; ¾ lb of Flour, 1 pint of Wheat, 1 Do of Kidney beans, ½ lb of Raisons (in lieu of 3 pints of peas and 7 oz of Butter) ; ¼ pint of Vinegar, 1 lb of Beef, 3 pints of Oatmeal (to be paid for).

Sund 14. Westerly Wind. It began to Rain at Day break and continued to do so till 11. It then clear'd up a little, but about 6 in the Evening came on a very Violent Storm of Thunder and Lightning, attended with a Torrent of Rain. It continued till 12 at Night and brought down as Usual a large quaintity of Stone and Rubish from the Mountain ; then abatted and afterwards came on but with less Violence. The Colonel was at Home some part of the time.

Mond 15. Westerly Wind. Raining at Guard Mounting. A Frigate belonging to the Enemy was drove from Algezira during the Storm last Night, and was carried up to the two Rivers. Their Camp and New Batterys, all Seem under Water. We do not keep up much firing now. This afternoon a Mortar was Fir'd from Montague Bastion to St Carlos upon a New plan of the Govrs. It was sunk

Digitized by Google

15th January, 1781. down in the Ground. It Seem'd to answer tolerably Well. N.B. 4 Inches of Rain fell last Night.

Tuesd 16. Westerly Wind. Raining very hard at Guard Mounting and continued so all the forenoon. The Colonel had the Whist party at his House. I was confin'd by great Indisposition to my Bed Room. I have been ill with this complaint, a Violent sickness, and a Rash all over me for two months past, but it is now Worse.

Wed 17. Westerly wind. Blowing Hard. Find myself Uncommonly ill, all this Day. The Enemy very quiet. A very Dark Night,—exceedingly Cold and Uncomfortable.

Thursd 18. Westerly Wind. In the Course of last Night a Cutter Privatteer, the *Tartar*, Captn Gibson came In. She is only 14 Days from Ports, is come with Dispatches to the Govr and to Captain Leslie, brings some Useful Articles for this Garrison. We learn that the King has declar'd War with the Dutch, and also that our Fleet had Return'd to Ports after having had Sight of the French Fleet. A great deal of News seems to be flying about.

Fryd 19. Westerly Wind. A better looking Morning than We have had of Late. There has been a Promotion of Majors by Brevet, We hear, and also that Genl Skinner Died on Christmass Day.* We have not got any letters by this last Cutter; the Articles which are to be Sold are belonging to Mr. Turnbull. We get a Round of Beef, 42 lb, as yet we do not know the price. N.B. Find it is to be 4½ Rials pr lb.

Saturd 20. Westerly Wind, fine looking Day. The Col went up to breakfast at the Rock Guard, came down in the forenoon very much indisposed, and continued ill all the Rest of the Day. He has been very indifferent Some Weeks, but has not Chused to confine himself.

Sund 21. Westerly Wind. The Colonel taken very ill, sent for Baynes. He continued in his Room all Day, and for the most part very ill indeed.

Mond 22. Westerly Wind. Colonel no better; still in his Room; takes Physic this Day, and does not see any Body. Very ill myself. Get 14½ lbs of English Mutton, 10 Rials pr pound.

Tuesd 23. Westerly Wind, fine Weather. The Colonel still in the same way, keeps his Room. Two of the Privatters, Captn Venture and McLorge, saild to the Eastward last Night, but I had not any letters on board. Whist Meeting at Judge Frazers.

Wed 24. Westerly Wind. Fine in the forenoon. The Colonel a little better; gets out into the Dressing Room; but grew much

* He was then 81 years of age and still Chief Engineer of Great Britain, which office he had held for 23 years. His recommendations on Green's reports on the fortifications of Gibraltar are in the British Museum: Add MSS. 10034. He was succeeded by Colonel James Bramham.

Digitized by Google

Worse at 3 oclock, and continued very ill all the afternoon ; his Dis- 24th January, order Seems mostly upon his Nerves ; attended with flying pains in 1781. Head and Breast.

Thursd 25. Westerly Wind ; the Colonel very indifferent, takes a Medicine Early in Morning, which affects Him. He continued greatly indisposed all Day. Miss Evelegh Died last Night, after having been long indisposed ; tho' not confin'd to the House above 12 Days. She was near 13 years old, was buried at Night, very privately, at South port.

Fry 26. Westerly wind, a fine looking Day. The Col has had a very bad Night, but grew Easier about Noon, and Walk'd into the Garden a little. A Man of Hardenburghs Deserted last Night. N.B. A Serjant of the 56th Deserted from Landport Guard last Sunday Morning ; He has left a Wife and children behind. He was in Debt.

Saturd 27. Easterly Wind. The Colonel has had a pretty good Night ; is better to Day but Seems low and Weak. 2 more men of Hardenburghs Deserted last Night. This makes four this week.

Sund 28. Easterly Wind. The Colonel very poorly this Morning and continued so all forenoon. A Vessel arrived from Leghorn this Day, belonging to Mr. Anderson, Loaded with Wines and Brandy &c, says that in Her passage here she saw a Man of Wars Long Boat with three Men's Jackets and some oars. It was the Boat belonging to the *Brilliant* Frigate. He could not get Her, as He was chased by two Xebeques. About Noon the Col grew exceedingly ill ; and We were obliged to send to Doctor Baynes who Bled Him, and He Seem'd rather Easier for it.

Mond 29. Easterly Wind ; the Col much better, and continued so till Evening, had then a little attack of His complaint, which indeed Seems mostly upon his Spirits. Two of Hardenburghs Deserted.

Tuesd 30. Easterly Wind. Very Dull Raw Day. The Colonel but very indifferent, and the Weather not good enough to allow Him to go out. 2 Setees arrived from Minorca in 20 Days, bring Word that the *Brilliant* was there when they came away, but is coming Down Here. These Vessels bring a few Supplies. The Col was better this Evening. Whist Meeting at Col Craigs.

Wed 31. Easterly Wind, better Day. The Colonel finds himself Low and rather Weak, but as the Weather was soft He went out on Horseback about half past 11, Mr Holloway with Him. It is just 11 Days since He was down stairs. He return'd before 2, and Seem'd tolerably well in Evening.

The whole of this Month has passed with very little Firing upon the Enemy, but a Number of Shott and Shells have been fir'd by Way of Experiments from the old Mole and other parts, some with tolerable Success, others very bad. The Enemy also have been trying many Experiments, and have got Mortars in Boats, and likewise

Digitized by Google

31st January, 1781. they fire shells from the Camp, Seemingly to know the Ranges, &c., but none pointed to the Garrison. They have an astonishing Number of Fascines and Traverses at St Carlos. During this Month We have had a good deal of Rain. We have very fortunately had a happy Number of Useful Articles brought by the Several Vessels, and the Garrison is well Supplied in some articles. The greatest Want now is of Firing and Fresh Stock. The flour also will be growing Short for the Inhabitants, and also Corn for the Poultry, and what few Cows and Sheep which are now remaining.

Thursd February 1. Easterly Wind. Colonel rather better. It was fine Weather at 12, when He Rode out to the Southward. In the afternoon He grew indisposed and was very poorly all Evening, and worse when going to Bed. A Man of the 56th in attempting to Desert fell down the Rock and was Dash'd to pieces. A Party of Miners who was Working not far from there, took him up. They likewise found the Body of a Serjant of the 73rd Regt who deserted about two Months agoe, and He had Shar'd the Same Fate. There is a Man of the 56th who was Concerned in the Same Scheme as the Man who has Suffer'd, and has turn'd Kings Evidence. He was to have gone off with the other Man and Some More; but was Disguised in Liquor and dropt Some hints, which occasion'd him to be taken into confinement, where He made a Confession of all He knew.

Fry 2. Easterly Wind. The Colonel has had a very bad Night; and could not get up to Breakfast. Seem'd very ill all the forenoon. The Govr here this Morning. A very Cold Windy Day. He walk'd out for half an Hour, but seems much worse than yesterday. Mr. Pierson Died this Night, aged 86.

Saturd 3. Easterly Wind. The Colonel rather better, did not go to Parade; or ride out to Day, continued pretty Well all the Evening.

Sund 4. Easterly Wind. The Colonel had a good Night, but as the Day turn'd out very indifferent He did not go out at all. Cold Raw Weather.

Mond 5. Easterly Wind, fine soft Morning. The Colonel tolerable Well, but did not go to the Morning Parade, and was very indifferent in the Evening. He did not go to the American Club.

Tuesd 6. Easterly Wind. The Colonel at the Parade; went to Whist Party at Col Kellets.

Wed 7. Easterly Wind. Col at Grand Parade, seem'd much indisposed all Day. Grew a little Better in the Evening, and when going to Bed.

Thursd 8. Easterly Wind. This Morning a Deserter came In from the New Battery, a Catalan. He reports that We have kill'd a great many People and a Captn of Horse. He says there are 8 Mortars keep Loaded in St Carlos Battery, to fire upon the Ships no doubt. He also says that the Serjant of the 56th who Deserted on 21st Jan hung himself in the Camp the Night He got there.

Digitized by Google

Captn Martin upon the Batterys this Day and Fired very much all the Evening, and the whole Night long. 8th February, 1781.

Fry 9. Easterly Wind. This Morning a Privatter Cutter arrived from Minorca in 14 days. She brings Word that the *Brilliant* Frigate is cruizing about. This Cutter is to go to Engd in a Day or two. This Evening the Colonel was not very well. I was also very ill.

Saturd 10. Easterly Wind; fine Day. Colonel at Parade, very indifferent in forenoon, better when going to Bed.

Sund 11. Easterly Wind. Cold Raw Day; Colonel rather better; and everything pretty Easy. I write a long Letter to my Sister and sent it to the office. All Well in Evening. A Man of 72nd Regt Deserted.

THE PROVISIONS FROM THE 12TH FEBRY TO THE 11TH OF MARCH 1781.

Officer pr Month. Bread as usual; 4 lb of Beef; 4 lb of Pork; 10 oz of Butter; 1 pint of Oil; 1½ lb of cheese; 4 pints of Peas; 4 pints of Kidney Beans; 4 pints of Wheat; 1½ Do of Rice; 1½ lb of Raisons; 4 lb of Beef, 12 pints of Oatmeal (to be paid for).

Men pr Week. Bread as usual; 1 lb of Beef; 1 lb of Pork; 2½ oz of Butter; ¼ pint of Oil; 1 Do of Peas; 6 oz of Cheese; 1 pint of Kidney Beans; 1 Do of Wheat; 6 oz of Rice; 6 oz of Raisons; 1 lb of Beef (to be paid for).

N.B. Soft Bread the first Week. Buisquit afterwards till further Orders.

Mond 12. Easterly Wind. Colonel rather better. All tolerable in Evening. The Cutter did not go as was expected last Night.

Tuesd 13. Westerly Wind. I write an other letter to my Sister, which I mean to send by Mr Logie. The Colonel better, and went to Major Vinogles. The Whist Meeting.

Wed 14. Westerly Wind. Col pretty Well and continued so; fine Day.

Thursd 15. Westerly Wind. Colonel at Parade, but finds his Eyes painful. He was very indifferent in the Evening. N.B. Two of the Oxen belonging to the Kings Works were sold yesterday, the Colonel not being able to keep them all lest the Grain and Provision for the Cattle would not hold out. He got 100 Guineas for them; one was Killed for the Market this Day, very good Meat; and Sold at a Dollar per lb.

Fry 16. Easterly Wind, an exceeding fine Day. The Colonels Eyes better, but finds an Uneasy pain in his Mouth. It seems to be a Rheumatick pain. We had a Large Company at dinner this Day, Davies family, Col Ross, &c, &c, and we Dress't our English Round of Beef. It weighed 42 lb, and turned out exceedingly good.

Digitized by Google

17th February, 1781. *Saturd* 17. Easterly Wind; the Colonel very much indisposed with his Mouth and Head. The Cutter not gone. A Cold Raw Day. Col ill at Night.

Sund 18. Easterly Wind. The Cutter gone last Nt. Much talk of the Memorial Relating to the Regts,* Most of which are gone home. Colonel very poorly in Evening.

Mond 19*th*. Easterly Wind. Colonel very much indisposed all Day. At Noon a *Polacre* came from Minorca in 5 Days, brings some letters and a few Supplies. This Evening all was very much Distress'd and Indisposed.

Tuesd 20. Westerly Wind. Cold Day but very clear and good Weather. The Colonel much indisposed but in pretty Easy Spirits.

Mem^m in Garrison Orderly Book.

"After each Regt is Reviewed they will march from the Sands and occupy the following Posts:—

12th Regt...Montague Bastion to South End of the Saluting Battery.

39th Regt...Ragged Staff, the fleche, and to South Shed.

56th Regt...Prince of Hesses Battery; Grand Battery, and to Montague Bastion.

58th Regt...From South Shed, the New Mole, and Rossia.

72nd Regt...Four Companys quartered at the bottom of Irish Town, to pass thro' the Sally Port, Navy Yard, and occupy the whole Cover'd Way of Water port. Six Companys Kings Bastion and to Church Battery.

73rd Regt...From Rossia to Dead Mans Hole and to send a Party to occupy Europa Gate.

The Commanding officers to Report to the Governor the Day before the Review the Manner in which they are to March from the Ground to their Posts.

56th and Hardenburghs not to Fire but to go thro' the Motions. The other Regts to Fire the Parapet firing."

Wed 21. Westerly Wind, very Cold indeed. The Colonel rather better. This Morning an other Vessel arrived from Minorca, brings a very good Supply of Wine, Oil, Sugar, and some Wood for Fires. Had a Fore Qr of Mutton from Genl Boyd.

Thursd 22. Westerly Wind, exceeding Cold. Colonel but indifferent, better in Evening.

Fry 23. Westerly Wind. Still indisposed, could not go out.

Saturd 24. Westerly Wind, still very cold. The Colonel rather better.

Sund 25. Westerly Wind. The Colonel better. Very cold Weather.

* This was a respectful memorial to the Governor drawing attention to the inadequacy of the officers' pay owing to the high rate of exchange and the great cost of all necessaries, and also to their non-participation in the recent extensive army promotions.—Drinkwater, pp. 140–1.

Digitized by Google

Mond 26. Westerly Wind. The Colonel a good deal better. The 12th Regt reviewed. All Well. 26th February, 1781.

Tuesd 27. Westerly Wind. Colonel Better; 39th Reviewed. All quiet with that Regt. The Colonel went out after Breakfast to the Guard Mounting, and Seem'd pretty well when He return'd. We had Captn Phipps family to Eat some of the Mutton; and Mrs Fancourt in Evening. Mrs Rogers Married this Evening to Lt Wilks of Artillery. Col Ross has made up a New Uniform, the Lappels of the 72nd Colour, but no No on the Buttons.

Wed 28. Westerly Wind, fine Morning. The Colonel not at the 56th Review, but went out afterwards to Guard Mounting. All pretty Well.

During the Course of this Month the Enemy have been very quiet. They are not often at Work at St Carlos. They realy seem as if they intended to remain as they are; Unless Urg'd on by any New Manœuvres of ours. One thing they certainly do, which is to be very Mindful of Signals; and other attentions upon their Coast. We can not help observing that We have Undoubtedly highly Mortified Don Barcelo; as it is Evident He can not keep so good a Look out as He did at first; or else We should not have got In so many little Vessels, &c &c from the East, all of which have been of the Utmost Service to this Garrison. Could We only get a Flour Ship and some Coals our greatest Wants would then be amply Supplied.

During the whole of this Month I have been a good deal indisposed, and keep Low, by a Constant Complaint that has attended me for the last 4 Weeks, which makes me keep still in the House, and some times greatly affects my Spirits. I have been Under the Necessity of keeping up, tho' with some difficulty, as the Colonel has been much indisposed, and it has been the Utmost desire and attention of my whole Mind to pay every possible Regard to his Health; the More So as his Complaints always fall upon his Nerves, and occasions many Unpleasing Consequences.

Thursd March the first. Westerly Wind. Fine Day. Colonel did not go to the 58th Review.

Fry 2. Westerly Wind. Very clear Day, but Cold. Colonel did not go to the Field to see the 72nd but met them as they return'd to their Alarm Posts. They made it very late; having so much to do. The Colonel not well. Colonel Ross did not Join the Regt but was in the New Uniform. He dined with the Corps at the Govrs.

Saturday 3. Easterly Wind. Blowing exceedingly hard. The Colonel went out to the Southward; to see the 73rd take their Posts. They had two pieces of Cannon in the Field, and made a very good Review. The Col at Mr Holloways in Evening.

Sund 4. Easterly Wind. Blowing exceedingly hard all Night. The Colonel went to Guard Mounting this Morning. A Brig taken

Digitized by Google

4th March, 1781. over to Algezira this Day: She had English Colours; came from the East; had 20 Guns.

Mond 5. Easterly Wind, fine Day. Colonel rather better; did not go to Hardenburgs Review, but to their Alarm Posts. It was a very Warm pleasant Day.

Tuesd 6. Easterly Wind. Cold Day. Redans Review. The Colonel as Usual, at Alarm Posts. A Flagg of Truce this Day from the Enemy, Relating to Major Freake, &c. Colonel at Captn Hastings this Evening. The Whist Meeting.

Wed 7. Easterly, Cold Raw Day. De la Mottes Review. Colonel as Usual. Just as the Regt had got to their Alarm Posts; viz., the Kings Bastion, a Man went off from Landport where He was on Guard. A Serjant observed Him Walking towards the Barrier Gates; and call'd to Him, but He at once set off, and altho' the Guard instantly Fired, as they did from the Lines and upon the Mountain, with Ball and Grape Shott, yet He escaped and got into Fort Carlos. There were more than 500 Musket Balls fired. He was one of the 72nd Regt.

Thursd 8. Easterly Wind. Cold and Raw. Colonel rather better, goes to Guard Mounting now, seems Low at Times, has got his appetite Well.

Fry 9. Easterly Wind. Same Weather. The Colonel better. Auctions every Day. Chiefly Prize and Ship Goods.

Saturd 10. Easterly Wind. Dry Cool Weather. We had a Heifer kill'd. It weighed 200 Wt. We did not sell any but parted it amongst our Friends, keeping what parts We chose. It turns out very pretty Looking Meat. It is about a Year and Eight Months old. A Sir Loin to Genl Boyd.

Mond 12. Easterly Wind. Looks Dull like Rain. The Govr much displeased this Morning, owing to the Neglect of the Two Captains upon Picquet last Night, one of which totaly forgot to go His Rounds during the Course of the Night. The other only Went half the Rounds. It is supposed some Serious Orders or Consequences will follow such a great Neglect of Duty. It occasions much Talk. One of those Captns was Captn Pigot 56th, the other a Hanoverian captain.

Tuesd 13. Easterly Wind. Still like Rain. This Days Orders were as follows:—"The Captains of the Picquet Rounds are in future to report to the field officer of the Day the hour they went their Rounds and the Commanders of all Guards are to mention in their Reports the hours they were Visited and What Rounds." The Whist Meeting at our House this Evening. We understand that some very particular orders are to be made known as to Morrow.

Wed 14. Easterly Wind; a little Rain this Morning. At Noon all Commanding officers were employ'd in reading a very Severe Note from the Governor in consequence of the late very great Neglect of

Digitized by Google

Duty in the two Captns upon the Picquet,—also a General Censure upon other Nightly and Daily Neglects, &c, a copy of which I will endeavour to get. N.B. It was not put into publick Orders. 14th March, 1781.

Thursd 15. Easterly Wind. Cold Day. A Man of the 12th Deserted last Night from Upper Alls Well. This Day all the Real Invilades are order'd to be got Ready to leave this Garrison. N.B. It is said they are to go on board the *Enterprize* this Night.

Fry 16. Easterly Wind. Raining fast in Morning, not much afterwards. I write a long letter this Day to my Sister, as did the Colonel to Mr Fisher; and sent them to the Office; it is supposed they are to go home by the *Enterprize* which is expected to go as this Nt. 3 Men of 56th concerned in a Robery, taken up to Provost.

Saturd 17. Easterly Wind. Soft Morning. The Frigate is not gone. Much Talk of the bad Behaviour of three officers of 12th Regt Relating to a Jew; in Refusing to Pay their Debts; and ill Treatment to the Man, &c. The *Polacre*, Captn McLorg Master, that went up to Minorca in company with the *Hannah* Captn Venture upon the 23rd of Janry, towards the East, came In this Morning, brings a small Quaintity of Casks of Flour, oil and Wine, brings Letters from the Govr of Minorca to our Govr and much Satisfactory News, Relating to our affairs in South America &c. Also brings an Account of the Attack upon Jersey, where we understand the French had made an attempt; and that they were greatly Hurt and drove off.

Sund 18. Easterly Wind. At Day Break it Rained; then held up till near 11. The *Tartar* Cutter, Captn Gibson Master, the same which arrived upon 18th Janry in Mr Turnbulls Employ, and has been a cruize to the East, arrived this Morning, brings some Supplies and fresh confirmation of our having been sending out Troops to the South Seas. The *Enterprize* not gone. I write a letter to my Daughter Helen, as did the Colonel to his Sister, and they all went to the Govrs office.

Mond 19. Easterly Wind; not any Vessels gone. This Day a Small Vessel came In from the East, which proved to be the Tender, belonging to the *Brilliant* Frigate. She was drove from Her anchors in a Gale of Wind, as she lay at Barcelona, and had been a cruize. She has Several Greeks on Board, was drove In by Contrary Winds and much bad Weather, as had the *Tartar* Cutter; who also had a Smartt Engagement with the Enemys Xebeques and Boats,—9 in all, which He drove off; and Behaved with great Spirit.

Tuesd 20. Easterly Wind. The two Men of the 56th Try'd for a Robery at a Wine House Mans in Irish Town, Colonel Godwin President, Lt Col Cochran, and three Majors and 8 Captains. N.B. It was expected that the three officers of the 12th would have been also Try'd, but the affair with the Jew has been made up. The Whist Meeting, which was to have been at Judge Frazers, was held at Col Craigs. It Rained exceedingly hard all Day and Evening.

Digitized by Google

21st March, 1781.

Wed 21. Easterly Wind. Not any Vessels gone. The Two Men are to be Hang'd. Auctions are now going on every Day, and the Prices of many Articles are greatly Reduced, as for example, Flour, tho' but a small Quaintity ; 200 Wt...22 Drs, Soap 1 R 4 Q per lb., Sugar (soft) 2 Rs pr lb. Beans are now in great plenty, owing to the late Rains. They were at first 4 Rs but now 1 R pr lb. Colliflowers have been Dear, Six and Seven Rials a piece. 3½ Inches of Rain in the last 24 hours,—it is a great happiness to Us.

Thursd 22. Easterly Wind. Fine Morning and Day. A Snow that came In last Sunday from the East, Bound for Liverpool, and who had come In in her way in order to get water, was carried over to Algezira. She had got as far as Caberita point when the Enemy fir'd 5 Shot. However it is conjectured that our own Boats could have brought Her back had they made any Trial. It was a Dead Calm. Mr Aldridch Died this Morning.

Fry 23. Easterly Wind. Raining at Guard Mounting, and continued So all Day. Had a few Friends at dinner, Col Ross, Picton &c, all Well. Some more papers are to be Read to Morrow by the Commanding officers to their Respective Corps, concerning those three young officers of the 12th and their Behaviour to the 2 Jews. It was supposed the affair could not have been so Well made up as it now is, as the offence was of a very Serious Nature, particularly of one of the officers, who had sold his Provisions more than a year agoe to the Jew, for which He Received Money down, and the Man was to have the Provisions, but He has never been able to draw them from the Victing office, owing to our present Circumstances. He therefore wanted his Money back of course, but instead of that was frequently ill used when ever He made any demand, and it was carried so high as to shut him up and Fire, tho' only with Powder, a Pistol at him. This disagreeable Business is finish'd as follows,—and most of it ended thus quietly owing to the Mildness of the Colonel of the Regt and the Govr. The Jew received the full Money, and double Interest for the time, as He made it appear He could have gained many advantages had He been posess'd of the Money, and the three officers gave Ten Guineas each to the Jew. It is hoped this will have a proper Effect upon the Unthinking Young Men who make a custom of ill using any Tradesman who asks for their Money.

Saturd 24. Easterly, a fine soft Morning. The Engineers all mett here at 12 oclock ; and the whole of the Jew Business was explained by order of the Govr and it seems as if it was well taken by every Body not having put it into Garrison Orders. The Colonel up to Willis in afternoon to meet the Govr and did not return till past 11 oclock. N.B. Yesterday We got a hind Qr of Mutton from Genl Boyd : Weight 18 lb, very good Meat.

Sund 25. Easterly Wind, a fine Rain all the forenoon, which will

Digitized by Google

be of the utmost Use to the Gardens. N.B. At this time there is an astonishing plenty of Vegetables, particularly Beans, all owing to the Rain. Col at Mr Holloways this Nt. I was taken very bad with a Complaint in my Head, Jaws, and Teeth, have not been out of my Room since Fryday, and was then very ill, have indeed been in a Daily State of pain and illness for Many Months past, as long as October last but *particularly bad* in Febry and March. 25th March, 1781.

Mond 26. Easterly Wind. Raining a little. Still I am very ill. Col Dined at Genl Boyds, Holloway at Booths. Col at Phipps in Evening. I hear He was in very good Spirits.

Tuesd 27. Easterly Wind. Raining again. My Head very bad. The Whist meeting at Judge Frazers.

Wed 28. Easterly Wind. A Brig coming In from Lisbon was taken over to Algeziras owing to the ill Management of the Master. Mr Ross was on board, and He and the rest of the Crew left the Vessel. He brought In a few Papers, by which We hear of a few alterations. The *Enterprize* and the *Fortune* Sloop sailed in the course of the Nt. The Prize *St. Firmin*, was intended to accompany them, but by some ill Management in geting under sail she Run foul of the Mole Head, so she now remains. Colonel at Captn Eveleghs this Evening. Find myself exceedingly ill indeed.

Thursd 29. Easterly Wind, still raining Hard. Am so very bad with the Complaint in my Mouth as obliged Doctor Baynes to take out a Tooth. Col at Home this Evening. He is now quite Well. A flagg of Truce came with a letter concerning Major Freake of the 39th Regt.

Frv 30. Easterly Wind. Raining soft and easy. Hear that Mr Adair of the 12th had got a Company in the 10th Regt and the Honble Mr Conway of the 39th a Ltcy in the 2nd Battalion of the Royal. Col at Captn Phipps, Stayed rather late. N.B. It is not so Early a Family as our own.

Saturd 31. Easterly Wind ; more soft Rain. Find that the Govr has given Mr Conway leave to go to England, and He is to go In the *Tartar* Cutter which is expected to sail this Evening. I therefore write a letter to my Sister, being willing to take every opportunity. Am still in great pain with my Head and Jaw. Can not go down stairs as yet. My having been so exceedingly indisposed in the Course of the last Ten Days has occasioned my making a few Mistakes, which I mean now to set Right. I have also omitted to mention that the two Unhappy Soldiers of the 56th Regt who were Sentenced to be hang'd both did Suffer upon the Wednesday 28th March.

N.B. I have already mentioned the Vessel from Lisbon being taken over to Algezira, but it was not on Wedy. It was on Thursday forenoon. She had 140 Butts of Wine, some Coals, and other Useful

Digitized by Google

31st March, 1781. Articles. By the News papers which Were luckily Saved, We understand that a Convoy is Certainly intended for this place, It seem'd to be ready at the End of Febry. It can not come too Soon, as Numbers of the Inhabitants are in great distress for the Want of Flour. It will become almost impossible to Raise half the Poultry We could wish, owing to the Want of Grain.

*

Sunday April the first. Westerly Wind. A Rainy Night which has brought the Wind to the West. The Cutter did not go last Night. The Guard Mounted at 7 this Morning. It continued Showery all the forenoon *and* Blowing very fresh. Find my Head and Teeth Still very painful. Articles of War Read to every Corps this Day.

Mond 2. Westerly Wind, fine Morning.

Tuesd 3. A Cutter, the *Resolution* arrived from Plymouth, having had a passage of 29 Days. She brings Coals, Rum, Sugar, and other Articles for Government ; and Several letters. We Understand the fleet may be Soon expected. By some letters I hear that the Royals certainly Sailed upon the 28th Novr. Colonel Ross has ask'd Leave of the Govr to go. Barcelo and his Ships seem very busy. Several Xebeques at the Orange Grove. Whist party Col Kellet.

Wed 4. Westerly Wind. The *St Fermin* and all the Vessels gone to the East last Night. Col Ross call'd to ask my Commands for England. He goes in the Cutter which is expected to sail the very first Moment of Fair Wind.† This Evening Lt Burley of the 39th and a party of Soldiers consisting of 30, together with Sailors &c made an attempt In Barges, and Boats to go to Caberitta point in order to Cutt out an arm'd Sloop and some Fire ships as it was said, that have been laying there some few Days. However their Scheme was not altogether Succesfull. It proved a very Stormy Night,—and to conclude this Story, They all came back about three in the Morning, not quite so pleasantly as They went, because at their Return, every one Concerned Seem'd to blame each other. Upon the Second of this Month the following was in orders,—The Soldiers will receive no more Biscuit after this Week, but will receive officers Bread, and the Loaves to be 2 oz heavier.

Thursd 5. Westerly Wind. All the Vessels return In every Night to the Orange Grove. There are two very Large Frigates there. The *Tartar* Cutter not sail'd as yet.

Fry 6. Westerly Wind. All the Same. We do not Fire at all Now,—only by way of Experiments. This Day it was in orders that

* Two pages are here left blank, evidently for the other corrections promised above.

† He returned on 13th November, 1781, to command the 72nd Regiment.

Digitized by Google

all the officers in each Corps are to draw their Provisions all together, and that it is to be divided after it is taken from the office. No Body can tell what Reasons are to be given for this. However it does not give satisfaction to any Body. 6th April, 1781.

Saturd 7. Westerly Wind. About Noon this Day a Vessel appeared from the West. The Gun Boats and the Xebeques went to try and Cutt her off. She got as Near to Europa as she could. The Master behaved Remarkably Well, and as Soon as our Guns could Protect Her all was Well. There were 9 Gun Boats besides other Vessels in pursuit after Her. All the Batterys that Bore that Way Fir'd, and She was got Safe Into the New Mole. She proves to be a Privatter Brig, from Glasgow in 14 Days, the *Eagle*, Captn Crawford, brings a Certainty of the Convoys having sail'd from England upon the 11th of last Month, also very good accounts of a Victory gain'd from the Dutch, Under Sir George Rodney. The arrival of this Vessel has put Us in better Spirits, as We can not doubt of the Convoys being on its Way. N.B. The Corps of Engineers dined at the Govrs this day. I am rather better now.

RATIONS OF PROVISIONS FROM 9TH APRIL TO THE 6TH OF MAY 1781.

Officers a Month. Bread 1 oz pr Day addition; Beef 4 lb 4 oz; Pork 4 lb 8 oz; Butter 10 oz; Raisons 3 lb; Pease 2 pints; Beans 4 Do; Wheat 4 Do; Rice 1 Do; Oil 1 Do.

5 lb of Beef, 4 pints of Pease, 12 pints of Oatmeal to be paid for.

Sund 8. Westerly Wind. A very fine Day, quite Warm. All Quiet with us and from the Enemy. A Large Suite of officers were at St Carlos this afternoon.

Mond 9. Easterly Wind. It is expected that the *Tartar* Cutter will go this Evening. Accordingly I write a Duplicate Letter to my Daughter Helen. The Colonel writes to his Sister; the Jones, &c &c. All those letters went Under Care of Mr Mackellar.

Thursd 12. This Morning at 2 oclock the Col was call'd up to inform Him that a Cutter was come In, from the West, who brings Certain News of the Convoy being just here. She was sent In by Admiral Darby who is Commander in Chief.

(Note: The relieving fleet came in on April 12th and the bombardment began the same day. The Journal only contains the following notes until June 3rd when it is resumed).

Cunningham 39th was wounded on Sunday 22 April; Died Sunday 6th May,—on Water port Guard. Doctor Chisholm 56 was Wounded, and lost his Leg upon Sunday 15th April.* He was Standing at the

* Drinkwater states that on the afternoon of this day the troops in the town began to encamp at the southward and to be distributed in the town casemates.

Digitized by Google

outside of the casemate Doors in Kings Bast. Lt Boig of the Royal Artillery was Wounded the very first Day of the Firing, Shot in the Shoulder.

Upon Sunday 29th April, 17th Day of Firing, the Enemy had at a Moderate Calculation fired 65,000 Shott and Shells.

Mr Lowe of the 12 Lost his Leg as He was coming down the Steps from Princes Lines, towards the Castle. He was employ'd as an overseer in Kings Work,—Good Man.

Gun Boats came all the time the Fleet was here and then upon the following Days after they went. N.B. They left Gibr (?) 20th April.

23rd first time after the Fleet, between 5 and 6.
30th 13 Boats Kings Bastion.
May 7th in Morning, between 5 and 6, 14 Boats.
Do the 11th, in forenoon 10 oclock.*
Do the 12th in Nt between 12 and 1. Taken up.†
Do the 20th at 2 in the Morning. Do.
24 at 2 in (?) Morning fatal Night. Do.
26 false alarm. Taken up.
June 1st at 2 oclock. Do.
June 3rd at half past one 2 Serjts Killed. Do.

They are always attended by Mortar Boats. When they come at Nt they always fire a Shell first, about 10 Minutes, and then begin with Shott and Shells. Their signal for Retreating at Night is throwing up Rockets.

Their Balls 26 lbs...Shells 13 Inch. They are about 40 Ft each Boat and carry 18 Rounds each,—Mortar Boats 12 Rounds. Upon the 31st in the Morning They fired 49 Shells, 190 Ball, and a Barr Shott of 35 lb Wt went Into a Large Tent belonging to the Qr Master Genl quite through the Tent; but did not do any hurt,—a very Remarkable Shott came Into our Garden about 10 Yards from the Bow Window. It fell upon a small Walling of stone, about 8 Inches high which was a sort of Bordering. The Shott broke into a Number of pieces, Drove a piece of the Stone Wall up into the Room, breaking the Glass of Bow Window. N.B. I have taken home a Large piece of this Shott, it being Esteem'd a Curiosity in its kind. N.B. The Garrison fir'd Grape shott, as well as shell and it was supposed must have greatly hurt them—2 Hours.

* On this date Drinkwater says "Scarcely a house north of the Grand Parade was tenantable."

† Probably these words refer to Mrs. Green—being an invalid—having to be taken up and carried to the Bomb-proof. See entry below under date June 3.

Digitized by Google

After the first fortnights Fire, the Enemy began to Slacken Fire. It was often 1,700 Rounds a Day,—particularly the beginning of May.

Upon or about the latter end of May they came down to 400 Rounds the Day,—particularly that was the Number upon Fryday 1st June.

A Jew Woman, a Man, and Young Lad, were kill'd on the Nt of the 23rd May by a Shell from Gun Boats, as were also three other men, and Many Wounded. We did not fire at all, as the Govr had Express'd Disapprobation at our firing on some other occasions. They Seem'd to be about half a Mile distant at one time upon the 31st May; but after that, somewhat nearer before they were drove off. The Large Howitzer upon Buena Vista distress't them a good deal this Night. *Enterprize* went out on Sunday Night 27th May. The *Flora* and *Crescent*, Frigates from Minorca went through on Monday Morning 28th. N.B. The Splinters of a Shell struck the Tin funnel of the Stove in Bomb Proof upon the Nt of 31st.

N.B. Omitted to mention that upon Monday 7th May the Gun Boats fired 345 Rounds of Ball and Shells. N.B. To be attentive in puting down these Mem^{a} and to place them in proper dates in order to avoid Confusion. A Ragusian came In on Thursday 31st May and was brought to by the Garrison.

June 3rd. Easterly Wind. Upon Saturday Night, or Sunday Morning at half past one the Gun Boats came, and began in a most Violent Manner. It was with much difficulty I was taken into the Bomb Proof. The Enemy fired more than ever. They came very close. *We* fir'd from the Garrison and a little from Shiping. We had 2 Serjants kill'd and Several others Wounded. It is hardly possible for pen, or even Words, to describe the distress and hurry this business puts us into.

This Day Sunday 3rd June, a very Large Fleet going through. We have heard of this by other means, but it appears very formidable. The Grand Hospital much affected last Night. Upon June 1st more than 200 men Wounded and 60 Dead of their Wounds, besides a Number of Inhabitants who have been Kill'd.

Mond 4. Royal Standard up at Grand Battery. By Noon the Enemy had sent three Balls through it. At one oclock We Fired every piece of Ordnance that Bore upon the advanc'd Work, being 65. No very material hurt was done to the Enemy's Works. The Day being Damp and an Easterly Wind it is supposed had some effect upon the Powder. About 2 there came round from the East a Line of Battle Spainish Man of War, 4 Xebeques and 2 Bomb Ketches, and went to Algezira. Many persons believed that the Line of

Digitized by Google

4th June, 1781. Battle Ship would have given a Broad Side to the *Brilliant* Frigate as she came very close, but all was quiet. N.B. The Gun Boats have been Commanded by Don Juan Moreno, of the Rank of Major Genl. This We heard by means of some Spainish Gazettes which came down from Minorca. N.B. Barcelo has been gone ever since the Firing.

Tuesd 5. Easterly Wind. All quiet from the Gun Boats, but a good deal of Firing keep up from the Enemy. It is now to be fear'd that the two India Men will be detained some time longer; as those ships laying over at Algezira is much against their going out. I am very indifferent still, and with much difficulty can get down stairs.

When the family were going to Bed, between 11 and 12 an Alarm was given from the Guard Boats, and instantly the whole Camps were up, and the Artillery went to the Batterys &c. I went down to the Bomb proof instead of going to Bed; had the Child taken up, a Fire made in Bomb Proof, and every thing made as Comfortable as it could be, every Moment expecting the Gun Boats. We all knew that one of the Line of Battle Ships had gone to nearer the Orange Grove in the Day, and it was thought she was Under sail in the Evening which led us to suppose she was to assist the Boats, but all was quiet from them.

Wed 6. Westerly Wind. A good deal of Firing as Usual. Could not make myself Easy in the Evening, therefore went again to Bomb Proof,—all quiet.

Thursd 7. Westerly. Cold Blowing Day. Am not quite so Lame as I have been; find myself growing very Tired and indisposed in the Evening. Therefore went to Bed before 10. A little before 11 an alarm was given of Vessels being coming very near our Batterys. It was Supposed it was either Fire Ships, or Bomb Ketches. In consequence all the Troops got up and went to those places appointed for Safety, except those on Duty. I was obliged to be taken out of Bed, and away again to Bomb Proof. This Disagreed with me more than I can express. Our Suspense Continued till past 12, and then it was clearly found to be 3 or 4 Xebeques that was going out after 2 Vessels which sail'd for Minorca.

Fry 8. Westerly Wind. All has remained quiet. I find myself exceedingly ill, the whole Day, indeed Uncommonly So,—obliged to go to Bed after dinner, and Dreadfully alarm'd lest the Gun Boats should come this Night; as I am realy too bad to bear the Moving. However they Luckily did not; and We all got a good Nights Sleep.

Saturd 9. Westerly Wind; Cold and Blowing hard. About 11 a very Loud Explosion was heard, and a very heavy discharge of shells, with the Utmost Rapidity from the Enemy's Camp. It was Instantly Seen to proceed from an accident amongst themselves. Their principal Laboratory Tent, under the Queen of Spains Chair, near the Catalan Camp, Blew up,—also a Building near to it. The fire was Violent; and extended to a Large Heap of Live shells, which Blew

Digitized by Google

up in a most furious Manner. Nothing could equal the Confusion the Enemy were In. This Tent is about four Thousand, five Hundred Yards from Landport. They beat to Arms. Their whole Line turn'd out under arms. It enabled our officers to form some Idea of the Number of Troops; which by observing the Number of Battalions seems by all accounts to amount to 10,000 men. Their Commander in Chief was Seen Riding with the Utmost Speed, attended by all his Suite in equal haste, towards where the accident happened. I plainly saw the poor Men Runing from the Flames. It continued Burning an hour and half and the bursting of the Shells more than half an hour. This accident must have done them most Essential hurt; and of course lower'd the Ammunition greatly. The Line of Battle Ship which Lay near the Orange Grove sent all Her People on shore to assist, and 6 Gun Boats went from Algezira to the Orange Grove. 9th June, 1781.

Soon after the accident the Enemy Fir'd a Shott from a 14 Gun Battery up to Williss. It came through the Embrasure; Kill'd one Artillery Man, blowing him to pieces. He fell upon an other who was Mortaly Wounded. 2 other Artillery Men were also Wounded by the Same Ball, but it is hoped they will Recover.

A List of the Killed and Wounded, from April 12th to the 4th June.

Killed. 6 Serjants, 1 Corporal, 1 Drum, 37 Private; Total, 45.

Died of their Wounds. 1 officer, Lt Cunningham of the 39th Regt, 1 Serjant, 16 private; Total, 18.

Wounded. 8 officers, 1 Surgeon, 1 Do Mate, 16 Serjants, 15 Corporals, 5 Drums, 201 Private; Total, 247.

Officers Names. Lt Lowe of 12th Lost His Leg, Surgeon of 56th Lost His Leg.

A Remarkable Event happened upon the 22nd of May; which I omitted to set down in its proper place; must therefore now Mention it.

At 2 oclock in the Morning, a Shell thrown from the Enemy, fell upon a Gun on the Church Battery, Line Wall, burst as it fell; a Splinter of which went to the South Bastion 360 Yds from Church Battery, and Cutt the Leaden Apron that Cover'd the Vent; and Fir'd the Morning and Evening Gun.

The Evening after the above a shell fell upon the Grand Battery, the bursting of which Fir'd one of the Guns, which Gun was Loaded with Grape shott and Laid for the Gardens. N.B. The Enemy are every Night in the Gardens and it is remarkable enough that one of their own Shells should be the Means of Sending those Grape shott amongst them; by way of Saving us the Trouble. Lt Cuppage of Royal Artillery was on the Flagg Staff Guard at the time.

Digitized by Google

10th June, 1781. *Sund* 10. Westerly Wind. This Morning about 7 the Line of Battle Ship came from the Orange Grove. The wind brought Her near to our Guns, and the Garrison fir'd at Her from Kings Bastion. Several shot struck Her. She sheer'd off and went to Algezira. The Enemy Fir'd a Good deal this Day. Went as Usual to Bomb proof.

Mond 11. Westerly wind. This Morning about 7 a Flagg of Truce came from the Enemy, informing us of our having made a mistake Yesterday; as it was a N—* Man of War that We Fir'd at. This Evening Mr Ward saild In an Arm'd Vessel call'd the *General Murray*, for Minorca. I wrote to my Son and my Sister.

Tuesd 12. Westerly wind. This Morning at half past one the Gun and Mortar Boats came as Usual. There seem'd to be a good Number. They were Fir'd at from every part that Bore upon them. The shiping also gave them a Warm Reception. Several of their shells burst in the air; one over our House; and the Fuzee Remains upon the Top of it. They Staid a little better than an Hour. An Unlucky accident happened in a Tent belonging to a soldier of the 56th. His wife, a very Good Young Woman, and a Young child of three months were Blown out of the Tent by a Shell. They were thrown into a Deep Gully, and Child Torn to pieces and the Woman much Burnt and otherwise Wounded. A Man this Day of the Working party kill'd at Willisses,—and in the last three Days 4 or 5 have been Killed.

Wed 13. Westerly Wind; all quiet from Gun Boats.

(The diary ends here abruptly, Mrs. Green's failing health probably rendering her no longer equal to writing after June 13th. She left the Rock and returned to England on the 22nd July, 1781, and died there on the 21st of June in the following year).

* This is left blank in the diary but Drinkwater states the ship was a Neapolitan.

Digitized by Google

MEMOIRS.

GENERAL SIR ALEXANDER TAYLOR, G.C.B., ROYAL ENGINEERS (BENGAL).

(Concluded).

By Col. Sir Edward Thackeray, v.c., k.c.b., late R.E. (Bengal).

On the 21st September the King and Palace fell into British hands. On the same day the Engineer Headquarters were established in the Palace of the Nawab of Juggar. Colonel Baird Smith left the city for Rurki two days later, too ill to travel except by bullock cart, and Taylor took up the command of the Corps at Delhi, somewhat to his disappointment, for he was burning to serve with one of the columns destined to put down rebellion in the North-West Provinces. His work in the Mogul Capital was to restore and re-model its battered fortifications, etc.; place the bastions in a state of defence; block up gates not in use, and strengthen the Palace.

His projects had the complete approval of General Wilson, but not that of Lord Lawrence, who considered them too belligerent and on too large a scale.

The following informal letter to him from the Chief Commissioner preaching moderation in armament sheds a light on their differences :—

"*October 8th.*—I have just been reading your Memorandum as to the best mode of defending Delhi. Now I want to say a few words to you on this matter. It seems to me that General Wilson and you on one side, and I on the other desire two very different objects. The point seems to be, which of the two is really desirable? If the object be to defend the town of Delhi, then you are both quite right. I have nothing further to say. But suppose it be desirable to let the inhabitants return, which I think it is, as far as the great majority go, could we not manage to mount a few guns on the walls of the Palace, if it were merely for show? Walls 9 ft. wide at the top would surely bear 9-pounders; and a few peeping over would have a sedative effect. If we are to defend the outer line, then of course we must keep out the mass of the people. But against whom is the place to be defended? There is no force, that I am aware of which can come against it. Our reputation in having taken it guards us against attack, even if an enemy existed, which it does not. My idea is that we should let the people back under proper restrictions. And this being admitted, can we not secure ourselves . . . by improvising a mode of arming the Palace with a few guns so as to overawe the town. Answer this please when time admits." °

° Quoted in Bos. Smith's *Life of John Lawrence*, I., p. 252.

Digitized by Google

In November Taylor marched to Agra in command of the Engineer Brigade, and on the 10th of December joined Seaton's Column at Alighur, (near which the enemy were said to be collecting), just in time to take part in the brilliant cavalry engagement at Khasgunj in which the Carabineers and Hodson's so greatly distinguished themselves.

The character of his activity at this time is suggested by the events occupying the morning hours of December 17th. It was the grey of the morning. The column was in movement, and in the neighbourhood of Puttiali, when distant shots were heard. Taylor and Hodson with some of his sowars rode forward to reconnoitre; they came on an apparently deserted village, the gates of which had been built up. Taylor sent back for some powder-bags, with which to effect an entrance. The two officers dismounted; Taylor disposed himself for a nap, while Hodson, armed only with a hog-spear, embarked on a voyage of discovery. "While waiting," writes Taylor, "Hodson wandered alone into an enclosed yard, at one end of which was a long low one-storied house. . . . Forcing in the central door, he found himself without sword or firearms in the presence of 10 swordsmen who immediately attempted to attack him. He stepped back one pace into the yard, and, as each swordsman came through the narrow doorway, so low that it impeded the immediate use of his sword, met him with a fatal spear-thrust. This occurred within a few yards of where we had been sitting. He had been away for a few minutes only, and when he took me to see what had happened in that short interval, I found 10 armed men, dead and dying, lying on the floor of the room." *

Taylor, to whom this incident was distasteful, went alone to the gateway to see how he would dispose of the powder-bags, and then strolled along the base of the village wall. He succeeded in climbing into a low tower springing out of this wall from which he emerged on to the flat mud roofs of the place. Not a sound was to be heard, or a soul seen. He was advancing cautiously, when he became aware of a man on a neighbouring roof on the other side of the street who was kneeling and taking aim at him with his matchlock. Without a moment's hesitation he rushed straight at him, clearing the narrow alley with a shout (his long jumps were celebrated) his disconcerted antagonist dropped his weapon and vanished. He then made his way to the wall with all possible speed, and was glad to see his men with powder-bags appearing on the scene! Having blown in the gates, and satisfied themselves that the village was deserted, they pressed on to Puttiali.

"Hodson's regiment," writes Taylor, "came on the enemy . . . entrenched in front of the village. It was still early morning. Our infantry and the General were a few miles in the rear. The en-

* The compiler of this Memoir who was attached to Seaton's Column saw Hodson mounting his horse soon after this incident.

Digitized by Google

trenchments seemed to be a parapet and ditch in a straight line. It was of importance that we should ascertain the positions of the guns . . . whether they were distributed along the face, and so, probably, immovable, or concentrated, and so, perhaps, movable. I got this information by riding along the front at a suitable distance. The whole 13 guns were tempted to fire on me in succession as I came opposite each of them. The result was a sketch of the position sent back to the General, with a suggestion that our field battery should come up with a suitable cavalry escort, place itself on the prolongation of the front, and open fire. This proposal recommended itself to the General; the artillery hastened to the front; placed itself suitably; and enfiladed the line of trench. Before our infantry could arrive and take part in the fight, the enemy, some 5,000 strong, broke, and fled, leaving all his guns, camp equipage, and carriage in our hands."

They were pursued by our cavalry—the Carabineers, the Lancers, and Hodson's Horse—for 7 miles.

Among the trophies were the elephant, silver howdah, and sword of the hereditary Commander-in-Chief of the Nawab of Furrukabad.

All these events occurred before noon on the 17th December.

Ten days later was fought the action of Mynpure in which Taylor again took part, and with which one of Hodson's most brilliant reconnaissances is associated.

Towards the end of the year Taylor joined the force under the Commander-in-Chief, and was sent to Cawnpore to prepare an Engineer Park for the Siege of Lucknow, and a bridge of casks for the passage of the Gumti River.

He was in command of the Bengal Engineers at the capture of Lucknow; led the main assault, and was wounded at the taking of the Begum Koti, a bullet passing through the leg a few inches above the knee. He never completely recovered from the effects of this wound.

"The hurt came to me," he writes to his old Addiscombe friend, Dan Robinson, "in carrying the Begum's Palace on the afternoon of March 11th. We had got in and had made good headway. I had mounted up to the highest pinnacle of the Palace to see what was ahead of me, and what further could be done. Pandy, in an adjoining house, took advantage of me!"

Hodson, also, was wounded (mortally), on the same day. "Capt. Hodson of the Irregular Cavalry," writes Colonel John Chalmers, from Lucknow, on the 12th, "the best cavalry officer in this, or, indeed, I think, in *any* other service, is very dangerously wounded, (mortally it is feared). . . . Major Taylor of the Engineers is also wounded, and although not so seriously, he has had to lie up, and is a great loss. As in reality he was the man who planned the taking of Delhi, so here . . . he has pushed on in the face of opposition . . . the immediate consequence of his wound was the giving up of a quarter of a mile of street we had got; as the Brigadier

Digitized by Google

is said not to have felt himself justified in holding it at the risk of so much loss without specific orders." *

On the 11th March, the day on which Major Taylor was wounded, the artillery and Naval Brigade under Sir William Peel battered and breached the Begum Koti with three 68-pounders.

This was then assaulted by our troops, the enemy losing about 500 men. The writer of this Memoir was ordered to take a party of Sappers to construct a battery at the side of the Begum Koti, and can well remember the storm of bullets. The Begum Koti presented an extraordinary spectacle, the great palace with its enormous mirrors, lamps and chandeliers, dead Highlanders and Sepoys lying in all directions.

At night a great part of the city appeared to be in flames. Fires were seen in all directions, while the shells from our batteries continued to pour into the city. The losses on our side during the operations were about 25 officers killed, and 50 wounded, and 800 men killed and wounded.

The force under Outram which had been advanced on the other side of the Gumti, now re-crossed on a bridge of casks, and pushed forward to capture the Residency. This was the last move and the enemy abandoned the defences. Still, there were detached forts held by desperate bands of natives, and it was not until the 21st that all fighting ceased.

During the operations a sad casualty occurred. At the Jumma Musjid nine cartloads of powder were found in a courtyard which General Outram ordered to be destroyed. As there was a well on the spot it was considered that the best method of destroying the powder, which was in tin cases, would be to throw them down into the water. A line of men was formed, and the cases passed from hand to hand as quickly as possible. By some fatality one of the cases exploded in falling. A flame of fire flashed up, and ignited case after case along the line, until the carts were reached, when they exploded. Capt. Clarke, R.E., and Lieut. Brownlow, R.E., who were superintending the operations, received such injuries that they both died during the night. With one exception every man forming the party to the number of 22 was killed. Strangely enough the only one to escape was the man who was throwing the cases down the well; he was rendered senseless, but eventually recovered. Elliot Brownlow's death was a loss to the Force, and to the Corps; to Taylor, who was with his friend† when he died, it was a personal grief.

As soon as Taylor was well enough to undertake so long a journey, he took his first furlough to Europe after an absence of 15 years. Before his departure he received a warm letter from Lord Canning, in

* Letters from Colonel John Chalmers, p. 66.

† Elliot Brownlow was the brother of another of Taylor's friends:—Henry Brownlow, R.E., who had had charge of the Engineer Park through the operations before Delhi, and cousin of Taylor's valued friend, Charles Brownlow of the 20th P.I., now F.M. Sir Charles Brownlow, G.C.B., etc.

Digitized by Google

which the Governor-General expressed his high sense of his services, and expressed his regret both for his temporary departure and its cause.

On his return to India in 1861, he was offered the Chief Engineership of the Central Provinces, but preferred to return to his old home and his old friends in the Panjab, and to his old work :—the Grand Trunk Road connecting Lahore and Peshawur, known in the Panjab as "Taylor's Road."

It was five years since he had left this Road, the supreme and sustained interest of his life, to join the camp before Delhi, and during those five years certain changes had been made in his plan, of some of which he disapproved; he longed to have the work in his hands again, refused the better appointment, and returned, as Superintending Engineer only to the Road which had begun to rise into being under his auspices 12 years previously. Among his most valued assistants during this phase of his work were Lieut. James Brown,* Lieut. Blair,† Mr. H. A. S. Fenner, and Capt. Dundas, V.C., his personal assistant, who was killed at Kabul in December, 1879, by the untimely explosion of a mine.

In 1863 Alex Taylor was appointed Chief Engineer to the Umbeyla Field Force, despatched under General Neville Chamberlain, to chastise the Hindustani fanatics who had stirred up ill-feeling on the Yusafzai frontier in 1857, had been driven from their stronghold Sitana in 1858, but had returned in 1861, had erected a new stronghold at Malka, whence they raided with impunity.

Taylor accompanied the Peshawur Column, which moved by the Umbeyla Pass and Chamla Valley past the territory of the Bunerwals, a large tribe reported friendly by the political officers. The column entered the Umbeyla Pass on October 10th and reached its highest point without meeting resistance. Its baggage and rear guard, however, owing to the badness of the road and the incompetence of drivers, did not reach camp till after the 22nd. This delay gave the tribes time to assemble on our front.

On the 22nd October, Chamberlain, considering that the preliminaries to a forward movement might be safely taken, ordered a reconnaissance to be made under the command of Colonel Alex Taylor. He was accompanied by two companies of Sappers, whom he set to improve the road. He found that the Pass was about 2 miles in length, unoccupied by any enemy, and the road fair. Shortly after noon he was joined by a detachment of cavalry under Colonel Dighton Probyn, V.C., and the 20th P.I. under Major Brownlow. The latter occupied the foot of the Pass, while Taylor rode on with the cavalry. The hills through the midst of which the party passed were occupied in force by the Bunerwals but, as far as Taylor could ascertain, none had descended into the valley, or attempted molestation.

* General Sir James Browne, K.C.B., K.C.S.I., R.E.
† Colonel Henry Blair, R.E.

Digitized by Google

On arrival, without incidents, at their destination, a village 4 miles from camp, Taylor "considered it desirable to take advantage of favourable conditions to push down the valley as far as was compatible with the General's order to be in camp by sunset." Leaving the main body of the cavalry behind, he pressed on with a small escort to a point 7 miles distant, made important observations, and rejoined the cavalry at 4.30.

The aspect of things, however, had changed. The Bunerwals had descended from the heights in great numbers with the object of preventing the party from returning to camp. Colonel Probyn* charged them in a most spirited way, and was supported by Major Brownlow.†

"By this time daylight had quite gone, and the latter part of the return journey was effected in dim moonlight. The enemy pressed Major Brownlow very closely, and several times got in amongst his men, sword in hand. Eventually, as we drew into camp, the camp picquets became engaged, and Major Brownlow's trying duties ceased," reports Colonel Taylor, adding :—"Nothing could have been better than the way the whole affair was conducted, nor than the conduct of both men and officers.‡

The fruit of this characteristic reconnaissance was reliable knowledge of 12 miles of road and its surrounding country.

At the end of the campaign it was decided that Malka should be burned in the presence of seven British officers, Alex Taylor and Capt. Roberts§ being of their number. Their escort consisted of four companies of the Guides Infantry; 25 Sowars; four Buner Khans, with 2,000 followers—the numbers of the latter however actually fell to 60, a sinister symptom. "Sir Hugh Rose," writes Lord Roberts, "was very angry that such a small party should have been sent to Malka and placed at the mercy of the tribes: 'It was madness,' he said, 'none of them will come back alive!'" The hazardous undertaking was carried through, however, successfully.

From the spring of 1865 to 1867 Colonel Taylor officiated as Chief Engineer of the Punjab; took furlough to England from February, 1869, to February, 1871; and again officiated as Chief Engineer of the Punjab from March, 1871, to March, 1872. In 1872 he was appointed Chief Engineer, his office being at Simla during the hot weather, while during the cold season he was engaged on tours of inspection.

"A Brevet Lieut.-Colonel (in 1858) with fifteen years' service, with

* Right Hon. Dighton Probyn, V.C., G.C.B.

† F.M. Sir Charles Brownlow, G.C.B.

‡ See Lieut.-Colonel Alex Taylor's report: dated Umbeyla Pass, 23rd October, 1863. Published by F.M. Sir Charles Brownlow. The Umbeyla Despatches.

§ F.M. Earl Roberts, V.C., K.G., etc.

Digitized by Google

an established reputation for high military capacity, and judged by men like Lord Napier, and Sir Henry Norman, to be equal to rising to any call on his powers, Taylor seemed to be clearly marked out for the highest place in his profession," writes the always well-informed *Pioneer Mail*,* in March, 1912. "In 1876 he was designated for the Quartermaster-Generalship at Simla, a much more prominent post than it has become now, but he was attacked by an affection of the eyes which under mistaken medical advice was held to be something which would threaten his sight if he remained in the East, and under this warning he returned home." The trouble proved nothing serious, but in the next year the Afghan War broke out, and had Taylor stayed on at Simla, possibly he, like his contemporary Sir Donald Stewart, might have ended his career as a Field Marshal.

When he returned to India in 1876, his sight completely restored by the wise treatment of the great German oculist, Dr. Meurer, he was appointed Deputy Inspector-General of Military Works, and President of the Defence Committee of India, appointments which he held until his retirement in 1878.

In 1878 he was appointed Secretary to Government in the Public Works Department. His name being mentioned in connection with this post before the appointment was actually made, the editor of the *Pioneer* wrote: "as a good administrator, as one of the best engineers in India, as a man whom the department would receive with cordiality, as one to whom England and India owe much . . . the appointment of Sir Alex Taylor will be as welcome to the public as to the official world at headquarters."

He was however prevented by urgent private affairs from entering on the duties which would have given so wide and suitable a field to his abilities and left India.

"Sir Alex Taylor, K.C.B.," writes the *Pioneer* again, "is now on his way home, and the troops of friends he is leaving behind him in India will be heartily wishing him happiness in his well-earned retirement. When he was lately appointed Secretary to Government in P.W.D., we referred to the services by which his Indian career has been distinguished, but the cordiality with which members of his own Corps seem always ready to enlarge on these is a sufficient evidence of qualities on the part of Sir Alexander Taylor, that cannot be recorded in Hart."

He succeeded Sir George Chesney as President of the Royal Indian Engineering College in 1880, and filled that office for a period of 16 years. Sir George, who had been Brigade-Major to the Engineer Corps during the operations before Delhi, in 1857, introduced him to the College as "the man who took Delhi."

"During General Chesney's previous tenure of office," writes the editor of the *Cooper's Hill Magazine*, "the College had pursued the

* Edited by George Chesney, son of General Sir George Chesney, K.C.B., C.I.E., C.S.I., M.P., R.E.

Digitized by Google

even tenor of its way in gradually completing the establishment of the Public Works in India; from 40 to 45 officers were yearly added to the Department, with the result that it quickly became completely staffed, and fresh officers were only required when vacancies were caused by natural wastage.

"During this time also the College curriculum was so arranged that all students were trained solely from a point of view of service in India. Shortly after Sir Alexander's entry into office, the number of appointments in the P.W.D. was very greatly reduced, and the problem then arose of trying to keep the College on a paying basis, when the previous attraction of an almost certain appointment in India became precarious. With this object in view the curriculum was modified, the purely Indian side of the educational programme was reduced, and the College was thrown open so as to attract students in engineering who had no intention of taking up a Government appointment.

"This change of policy necessitated considerable alterations in the course of study, and involved courses of instruction in subjects that had hitherto been entirely ignored, or at best only very casually alluded to. Under these conditions, expansion became necessary in two directions, viz. :—Additional accommodation, and increased staff.

"In addition to expansion on the engineering side, further progress was made by the establishment of a School of Forestry; and it speaks volumes for Sir Alexander's ability as an administrator that all these expansions were carried out and produced the fullest measure of success in all directions."

"When Sir Alexander Taylor came to Cooper's Hill," writes one of the most distinguished of its professors, "he became at once a favourite with all members of the College Staff. There was nothing of the 'President' about him;—he regarded the Professors as his colleagues, in the strict sense of the word; they had their duties which were distinct from his, and in any changes in those duties, and in anything relating to the educational work of the College, he consulted them without reserve.

"In all matters relating to the scientific studies of the College he acted on the best advice that he could get. When vacancies occurred on the Staff, he suppressed any desires that he entertained with regard to the new appointments, and made such appointments entirely on the recommendatien of his colleagues.

"This strict conscientiousness characterized the whole of his *régime*; he always acted with loyalty to the India Office, and especially to its requirement that expense was to be avoided.

"It was thought by some, that when the number of students at the College was greatly reduced, owing to congestion in the Indian Public Works, he should have recommended the Government to send the Royal Engineers to Cooper's Hill, where the training was in

Digitized by Google

many ways most suitable. He was rather in favour of this plan; but there were of course some difficulties, and he thought that the military authorities would regard them as insuperable, and refuse his request. Subsequent events, however, proved that there was at least a reasonable chance of acceptance at the time.

"He was an intensely religious man, and he regarded moral discipline and example as the highest interest of the College. His life was in accordance with his religion, which was a simple system, aloof altogether from rites, ceremonies, and ritualistic observances:—His conscientiousness and strict honesty were the visible expression of his religion. He attached great importance to regularity on the part of the students in their attendance at the College Chapel.

"It was always very pleasant and instructive to discourse with him on the events of the Great Indian Mutiny; but from his account no listener would ever imagine the important part that he took in them.

"His last months at Cooper's Hill were spent in revising the College rules, even down to the most minute details, for the guidance of his successors, and when he left it, it was felt by all at the College, both professors and students, that they had lost not a President only but also a companion and friend."

Though no longer young when he succeeded Sir George Chesney he was "in spirits, the youngest member of the College Staff. He was an enthusiast in all that concerned the interests of the place, and having been a keen yachtsman threw himself into boat sailing on the Thames with boyish recklessness on the subject of capsizes."*

"It is said that the students sometimes turned his enthusiasm for yachting to their own advantage, and on being summoned to the 'Duke's study for a carpetting,' would maliciously introduce the subject of sailing, and, by propounding some new 'gym' hoped that they might escape the full penalty of their misdeeds. . . .

"Shortly before he resigned the Presidency of the College, and when he was not far short of 70 years of age, he was seen on one occasion to climb up to a third floor window of what was known as the New Block at Cooper's Hill with the object of testing by personal trial, the possibility of obtaining ingress to the College by other routes than that of the Porter's Lodge!

"Sir Alexander was loved and respected by every one with whom he came into contact; he was a firm friend, and always did his best to help those who were in any sort of trouble. He was a strict disciplinarian, but generally had a strong tendency to take a merciful view of a case. But in the event of anything of grave importance taking place, he was the very last person any student of Cooper's Hill cared to meet." †

The students knew that their President had been a noted athlete in his young days:—a "record" long jumper, a redoubtable football

* *Pioneer Mail*, 1912. Obituary Notice.

† *Cooper's Hill Magazine*, March, 1912. Obituary Notice.

Digitized by Google

player, an enthusiastic fisherman and sailor, and they had been told by distinguished visitors, whose names are among those of the men who made Northern India, of some of his famous exploits :—of the swim across the Indus at Attock, for instance ; and of the adventurous journey in a corracle down the unnavigable mountain torrent, the Punch, during which he was accompanied only by an Attock boatman on a mussuck, etc.

The personality of such a man could not fail to appeal to young men, and the Cooper's Hill men of his day will always think with regret and admiration of their old chief.

On leaving Cooper's Hill, Sir Alex Taylor gave up all public work. His doctor put a stop to sailing ; and, cut off from his work, and from the active pursuits which had been the salt of his life, he gradually lost all muscular strength, though not health.

The few friends of his early strenuous Punjab days who still survived now rallied about him :—F.M. Sir Charles Brownlow, F.M. Earl Roberts, Mr. James Macnabb, Sir Donald Macnabb, Mr. George Ricketts, Sir F. Maunsell, Sir Dighton Probyn, and others ; the associations clustering round them bringing the brightness of happy memories into his life.

He passed away at midnight, February 25th, 1912, at the age of 86, in his own home and surrounded by those he loved.

The War Office proposed that he should be buried with military honours, but his family felt that he would have preferred to be laid at rest as unostentatiously as he had lived. He was buried in the village churchyard of Englefield Green, a large concourse of friends from the neighbourhood being present, and many of his Cooper's Hill subordinates as well as a few of his old Delhi comrades :—General Sir Frederick Maunsell, K.C.B., Colonel Commandant, R.E., General Sir John Watson, V.C., General Pemberton, and others. Lieut.-General Sir J. S. Ewart, Aide de Camp General in Waiting to the King, Adjutant-General to the Forces, was also present, having been graciously sent by His Majesty the King to represent his high sense of the value of the services of his loyal servant.

It is of course impossible in the space available to make more than a passing allusion to many of the distinguished services rendered by Sir A. Taylor during his long career.

But his old comrades and brother officers have determined that these services shall not be allowed to pass into oblivion, for, in addition to the portrait the Corps has decided to put in the Headquarters Mess, a strong committee has been formed, with Lord Roberts as chairman, Sir F. Maunsell as vice-chairman and Colonel H. Finnis as hon. secretary, and has decided to erect a monument to him at Delhi. By this means his memory will also be preserved at the place where more than half a century ago he contributed so largely by his valour, foresight and professional ability to the capture of the city, and, consequently, to the maintenance of the British Empire in Northern India.

Digitized by Google

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

Lieut.-Colonel Albert Charles Smith, R.E.

Digitized by Google

LIEUT.-COLONEL ALBERT CHARLES SMITH, R.E.

By H.M.V.

LIEUT.-COLONEL ALBERT CHARLES SMITH died at 87, Cadogan Gardens, on the 3rd March last, aged 69, having been born at Woolwich on 5th June, 1842.

He was the second in a family of eleven children (six sons and five daughters), son of Henry Smith, Esq., by Charlotte Gordon, only child of William Burgess Whitnall, Esq., of the Ordnance Office. Henry Smith was for over 50 years in the War Office, and finally became Accountant-General retiring on full pay in 1861. At the time of the Crimean War he had very arduous and difficult work, and Mr. Disraeli mentioned his services with approval in the House of Commons. Soon after Albert's birth his father took up his quarters in Devereux Tower in the Tower of London, and the third son, Clement (now Canon of Windsor and Rector of Whippingham), was born there. Albert and his brothers spent their childish days in the Tower of London, but later his father removed to Peckham, and Albert and his elder brother Frederick (afterwards a merchant in China), attended the Camberwell Collegiate School as day scholars.

In August, 1853 (when eleven years of age), Albert joined Carshalton House near Croydon, at that time the preparatory school for Woolwich. After five years there he proceeded to the "Shop," and left it on 1st November, 1860, with a Lieutenant's Commission in the Royal Engineers. After going through the usual course at Chatham he was ordered to Pembroke.

He lost his mother in January, 1860, when he was at Woolwich and in May three years later his father died. He thereupon resolved to volunteer for service in India so that he might be in a position to assist his younger brothers now under the guardianship of his uncle, Frederick Smith, Esq., who in 1866 went to reside at Binfield, in Berkshire.

He left for India November, 1863, landed at Madras 5th January, 1864, and was a few weeks after ordered to join the Madras Sappers (now the Queen's Own) at Dowlaishwaram, close to the site of the anicut across the great Godavery River. During his stay there he was engaged on drill, fieldworks, etc., and studied Telugu, the language of that part of the country, but twice he had most interesting shooting for ten days with Arthur Frank Hamilton (who became a lifelong friend until his death as General in 1898) in the Godavery jungles in the vicinity of the beautiful gorge of the Godavery River. This gorge for 2 miles is so narrow that a stone may be thrown from the bank to the middle of the stream—on both sides the hills rise

Digitized by Google

to a height of two to three thousand feet with steep sides clothed from water's edge to summit with luxuriant tropical vegetation. The depth in summer season varies from 100 ft. to 200 ft., floods rise 50 ft. above this when there is a torrent 250 ft. deep and no craft that ever floated could stem the current. His service with the Queen's Own Sappers only extended to some seven or eight months when he was directed to join the Department of Public Works in the Kistna District and he reached Bezwada on 27th September, 1864.

In October he was placed under the order of Capt. Hasted, R.E., and took charge of the construction of Cowtram Loch, on the Buntamilly Channel, some 12 miles from Masulipatam.

A few weeks after he had a most disagreeable experience for on 1st November occurred a most disastrous cyclone which caused the sea to rise many feet above its normal level, inundating the country for many miles, and almost destroyed Masulipatam with a consequent loss of life of 30,000 people. This was one of the most terrible inundations known to history.

About 8 a.m. on 1st November the barometer was rapidly falling and at noon rain set in with violent gusts of wind, by 8 p.m. the wind began to shift to E. by N. increasing in violence so that trees were blown down and roofs lifted off houses. At 10 p.m. the gale was E.N.E., and now came another danger more to be dreaded than the wind. At this hour it was spring high tide at the tidal lock. The sea driven into the bight of the coast at the very moment of high tide, an enormous wave 13 ft. above high tide was borne inland by the gale. The flood was at its height at the fort about 11 p.m. and in Masulipatam half an hour later. The huge wave penetrated at one point 17 miles from the coast and extended along the coast for some 80 miles, inundating some 780 square miles of country.

Before midnight the water began to subside and then it seemed that if possible the horrors of this awful night increased. The terrible wave now receded with a continuous roar uprooting and carrying almost everything before it to the sea—huge blocks of masonry on the causeway between the fort and the town being carried away many yards. It was long before Masulipatam recovered from the disaster. Fortunately for Smith the flood did not quite reach Cowtram.

At the time he was living in a rough shed near the lock. As it seemed likely to collapse he retired to his so-called office (a shed of a similar kind); presently the house came down and an hour later the office also fell. Meantime he had taken refuge in a cowshed with 20 natives and this building they managed to hold over their heads, standing the while, wet through till the morning when Smith went to Cowtram village and put up in a shed there. For several days he had to remain there endeavouring to put things to rights and of course for some weeks there was an immensity of emergent work to be done in closing breaches, etc.

Some natives in a parlous condition came in from Masulipatam

Digitized by Google

on their way inland and with his usual kindness he gave them dinner, looked after their comfort for the night and rose early next morning to see them off. Capt. Hasted was naturally anxious about his assistant and meeting a man from Cowtram he asked him how the Sahib was. The man replied " Master sitting tight at Cowtram."

In the following September he took charge of the Irrigation Works, Chabrole District, in the Western Delta, and this he held for some years.

He served in the Kistna for some six years till September, 1870, opening out a new main canal with all its necessary locks, weirs, bridges and distributary works.

Towards the close of August, 1868, he went on three months' leave to Northern India in company with a great friend, Andrew J. Stuart, of the Madras Civil Service. They reached Calcutta on 8th September and after a stay of ten days went to Darjeeling. On the 30th they were at Delhi and thence visited Agra, Cawnpore, Lucknow and Allahabad. After this to Jubbulpore and the Marble Rocks where they stayed five days. They then returned to Benares, etc., reaching Calcutta 14th November and ten days later were back again in the Kistna. Towards the close of 1870 he again went on leave to Madras, Bangalore and Ooty and finally left for England on a tour of home duty in February, 1871, joined at Chatham in August and a few months after was posted to Woolwich District.

During all his time in India he devoted a good deal of attention to shooting. Although he had but little opportunity for big game shooting he shot much small game and employed some of his spare time in making drawings of the birds he shot. He made a fine collection of these paintings but unfortunately his drawings were lost or stolen. He had a great love of animals and was especially fond of dogs and horses. This love of sport and animals was inherited from his grandfather, Mr. W. Whitnall, who lived in Kent and used often to take Smith and his brothers into the country for shooting and coursing.

When he went home in 1871 his uncle Fred (the guardian of his younger brothers) resided at Binfield, in Berkshire, and it was there he first met his future wife. On 12th June, 1873, he was married at St. Mark's Church, Hamilton Terrace (by the late Canon Duckworth), to Constance Mary, third daughter of the late Thomas Craufurd, Esq., of Baidland and Ardmillan, Girvan, Ayrshire.

In February, 1865, Capt. Hasted had left the Kistna and Capt. C. J. Smith took his place. Two of the same name being in the department in the same district, it became necessary to distinguish one from the other and it was then that the two designations "A.C." and "C.J." were introduced in speaking of them and these sobriquets stuck to them all their lives. On 24th August, 1873, "A.C." was promoted to Captain and three months later, accompanied by his wife, he landed in Bombay, on 5th December was appointed Executive Engineer, St. Thomas' Mount, and before the close of that month they paid me a visit at Bangalore where we had

Digitized by Google

a joyous Christmas, our mutual friend, Arthur Edgcome, of Engineers, being also with us. In May following to our great sorrow Capt. Edgcome died at Pennaconda, his death being due to dysentery and was caused by his devotion to duty, as he insisted on continuing to work when he should have taken rest.

"A.C." remained in the Chingleput District, Headquarters, St. Thomas' Mount, being in charge of military works—with many irrigation works in the district—till June, 1877.

While he was in this position the memorable visit of the Prince of Wales (after King Edward VII.) took place (11th to 18th December, 1875). The Prince remained a week which was full of festivities—receptions, dinners, a grand ball at the Madras Club, a race meeting at Guindy and a meet of the hounds at St. Thomas' Mount—which last was arranged to take place in the grounds of Chabrole Park where Capt. and Mrs. A. C. Smith had the great honour of entertaining the Prince and his suite to breakfast. King Edward never forgot their hospitality.

In June, 1877, "A.C." went home on furlough, and returning two years later was posted as Executive Engineer to South Arcot, his headquarters being Cuddalore, and as I was Superintending Engineer I had ample opportunity of appreciating the great value of his services. Here he had charge of large irrigation works and roads, bridges and other buildings extending over a district of 5,000 square miles. We visited together all parts of the district and went to Pondicherry (French territory) and paid a visit of inspection to the celebrated fortress of Gingee, some 40 miles N.W. of Pondicherry. I had been also in close connection with him for several years in the Kistna and visited many parts in his company—amongst other places the beautiful Fort of Condapilly where it was customary from 1865 to 1867 for the younger officers of the district to assemble for a 10 or 12 days' picnic at Christmas. This was a most enjoyable holiday, and everybody was full of life and spirits. The daytime was occupied in shooting and climbing among the beautiful hills. After dinner singing and jollity, occasionally winding up with fireworks and a bonfire, everyone friendly and cheery.

"A.C." was transferred to the Presidency Division, 13th September, 1881, but re-transferred to South Arcot in the following April.

Two years later he was sent to the Neilgherry Division (August, 1884) which included military works, Government headquarters and new drainage and water supply of both Ooty and Wellington besides the roads in the coffee districts of Wynaad.

In the year 1884 he went to Australia for a few months and visited one of his brothers at Sydney. As he was an officer of the Royal Engineers the Government of New South Wales gave him a free pass over their railways and asked his opinion on various matters connected with public works in the Colonies.

He remained on the Neilgherries for two years and in August,

Digitized by Google

1886, was appointed Superintending Engineer and transferred to charge of 6th Circle, 29th November, 1886, headquarters Trichinopoly, having in August acted for me as Superintending Engineer at Bellary till November while I was in England on leave. In February, 1887, he went on furlough on private affairs for 22 months returning in November, 1888, and was transferred to 4th Circle in December, 1888. He retained this till May, 1889, when he handed over charge to me and proceeded to the care of 6th Circle and works connected with the famous Periyar Irrigation Works till April, 1891.

In the meantime he had been promoted to Major, 1st July, 1887, and Lieut.-Colonel, 8th January, 1888, having on 20th October, 1886, elected for continuous service in India. From the 8th April, 1891, he officiated as Chief Engineer and Joint Secretary to Government with charge of General Buildings and Roads Branch till the following July when he went on special leave to England. Returning on 17th January, 1892, he was sent to 6th Circle again as Superintending Engineer, 1st Class, which included in his charge the beautiful Pulney Hills.

On completion of five years as Regimental Lieut.-Colonel he was placed on half-pay, 8th January, 1893, and a few weeks later he went on furlough for 11 months and did not again return to India.

I have omitted to mention that in August, 1876, "A.C." came to stay with me at Bangalore, and from 20th September to 2nd October travelled with me while I was on tour to French Rocks, Seringapatam, Mysore and the lovely falls of the Cauvery at Sivasamoodrum.

After leaving India being still very fit for active service he decided to apply for an engineering appointment under the Local Government Board and the late Lord Wenlock, who was then Governor of Madras, wrote to him to say that he hoped he would be successful in obtaining his desire "as from the opportunities I had of seeing your work while on duty in the Presidency of Madras I believe you would be able to carry on the work which you are anxious to obtain with credit to yourself and satisfaction to the Government." The result of his application was that on the 1st March, 1897, he was appointed Temporary Engineering Inspector of the Board and was added to the Permanent Staff on 24th May, 1902. On the 5th June, 1907, he had to retire from this post having reached the age of 65. The work of the Inspectors consists in holding enquiries in all parts of England and Wales on all sorts of subjects, water supply, sewerage works, street improvements, alterations of local boundaries, etc. They sit very like magistrates and take evidence of the facts elicited and then make reports to the Board with recommendations. The Board consider all the facts and act. During the year each Inspector holds 80 to 100 enquiries and during the 10 years "he carried on his duties well and to the entire satisfaction" of the Head of the Department who at first was Major H. Tulloch, C.B., R.E., and later Colonel Hasted, R.E.

Colonel A. C. Smith during his 30 years' service in India had charge

Digitized by Google

of all kinds of Engineering works, including large irrigation schemes, military works, and roads and bridges, and in all he undertook he was entirely successful. His character was a noble and a loveable one. He was sweet-tempered, sincere and genial with much quiet humour, considerate for others, never said an unkind word of anyone, in fact I believe he never thought harshly of any except when perhaps impatient at injustice to others. I knew him for nearly half a century and have seen him under all varieties of circumstances in camp and in society ; we travelled together on many occasions and have frequently visited one another in our homes and he was always the same true and genuine friend, given to hospitality and full of the milk of human kindness. I deeply regret his loss as the snapping of a link with many most pleasant phases of life. In his dealings with his subordinates in India his conduct was invariably marked by kindness, urbanity and much toleration for their errors and faults—he was just to them but full of clemency and as a result they almost adored him. To meet him was to me the greatest pleasure and to part was invariably a source of regret.

As regards his work (of this I had ample means of judging) he was earnest, painstaking and thoroughly conscientious, clever and versatile. He had much knowledge of art, could paint and act ; had considerable knowledge of music and possessing a fine baritone voice which he used with skill. His character may be summed up in the words cheerful, constant and friendly, altogether admirable and delightful and a true English gentleman whom to know was a pleasure and a privilege.

A mutual friend of ours (Colonel H. D. Love, R.E.) thus writes of him :—

"The salient features of his character were his straightforward honesty, patriotic sense of duty, unselfishness, modesty as to his own abilities and attainments, kindness of heart, *bonhomie* and hospitality. He had multitudes of friends and so far as I know not an enemy in the world. As for his work, his conscientiousness, his tenacity of purpose, joined to his known abilities and his sterling common sense, are a sufficient guarantee that all he undertook was well and thoroughly done."

For some time before the end his health was not good, but it did not occasion serious alarm. I stayed with him for a few days in December when he was fairly well, but towards the close of February he became seriously ill and on the 3rd March he passed away. He leaves a widow and a son, Major Harry D'Arch Smith, of the Suffolk Regiment, who is married and has two little boys.

Colonel A. C. Smith's funeral took place on 7th March at Brompton Cemetery where his remains are interred. His brother, the Rev. Clement Smith, Canon of Windsor, officiated at the ceremony.

Digitized by Google

TRANSCRIPT.

THE GROUP SYSTEM OF FORTIFICATION APPLIED TO FORTRESSES.

Extracts from an article by D. Kolosovski in the December, 1910, number of the *Injenerni Jurnal.*

THE chief object of fortresses is to safeguard, and consequently to facilitate, wide strategic operations of armies in war. A fortress which occupies an important point in the lines of operation between two combatants, gives essential assistance to the active operations of the side which possesses it. A fortress pushed far out towards the frontier, will, with the help of the forces using it as a pivot, cover the mobilization and deployment of the field armies; another in some other locality or at some other period, by the action of part of its garrison, may hamper the action of a considerably larger force of the enemy in the open, or it may attract towards itself his field armies, compelling them to modify or even entirely to interrupt their offensive movements, and thereby afford leisure to its own side to organize its forces for the attack.

A fortress must be sited with strict reference to the plan of campaign which is most advantageous to the government in a given theatre of war. It must be given such strength in fortifications and armament that it may enable a comparatively weak garrison to hold out against greatly superior forces of the enemy, and it must be so designed that, with a slight increase of garrison above that considered as the minimum necessary for its passive defence, it may be able to actively influence the surrounding country—for a comparatively weak field force acting in the neighbourhood of a fortress can operate boldly against superior forces of the enemy.

History gives many examples of fortresses submitting to sieges with garrisons greater than those for which they were designed, and it is important that they may with such an increase obtain corresponding advantages. In other words, the skeleton of the fortress, with its permanent works, should allow room for and afford support to the development of subsidiary defences, including possibly even complete positions of temporary or field character, lying to the front of, or adjoining and in link with, the fortress positions.

The present design of a fortress consists of a closed circular position with forts as its *points d'appui.* In the intervals between the forts there are weaker works or infantry trenches, and behind these, in a belt of 1 to 2 *versts* in depth, are the fortress batteries. In this belt, and partly in rear of it, are the expense magazines and protected accommodation

Digitized by Google

for the gunners. The main reserves of artillery, ammunition, and supplies are concentrated in the central fortified enclosure of the fortress.

In 1906 and 1909, two designs of fortress construction were devised in Germany, both of which appeared after the experiences of Port Arthur had been fully digested. The most striking difference between them is that in the latter the radius of perimeter is reduced from 8·9 kilometres to 6·7 kilometres.

The present effective range of the shrapnel and high-explosive fire of siege artillery is 8 kilometres, and consequently, with the contemplated approach of an investment line to within 4 kilometres of the fortress perimeter, in neither of these two cases is the centre of the fortress safe from accurate fire. The guns of the fortress have a still greater effective range, up to 10 and 12 kilometres, and thus it is now considered possible, by reducing the fortress radius and obtaining thereby other advantages, to risk the bombardment of the central enclosure. A reduced perimeter means reduction in the cost of works and the cost of garrison, and men saved for the field armies.

Further differences between the two schemes show how greatly the cost of fortress construction is increasing in the light of modern requirements. In 1906 the Germans considered it sufficient to place forts with artillery in turrets, or groups of forts and turret batteries, at intervals of 8 kilometres, with intermediate works as permanent infantry positions in the intervals, at 2½ to 3 kilometres apart. Now, they think it necessary that the permanent forts should be in immediate rifle or machine-gun connection with one another, *i.e.* 1,000 to 1,600 metres apart, and that they should contain no artillery except for opposing storming parties, or in a few cases in turrets for sweeping the approaches to the infantry positions in the intervals. All the fortress artillery is now sited in the intervals and behind them, preferably in turrets, but partly in open emplacements.

Owing to the intensity of modern artillery fire it is now considered necessary to provide for the deployment of a great number of guns of all kinds in the short extent of front attacked, and for this purpose in the fronts liable to attack a large number of permanent works, magazines, observation stations, shelters, telephones, roads, etc., must be provided in the artillery belt or immediately behind it. As most of these works cannot defend themselves, and are therefore liable to destruction should the enemy succeed in occupying the intervals between forts even temporarily during an assault, it has become necessary to hold the intervals continuously with infantry works. These works take the form of closed groups of trenches, surrounded by obstacles, and provided with shelters strong enough to resist the shells of field guns and the splinters and shrapnel of siege guns. The groups are prepared for garrisons of from one to four companies, and the larger groups are provided with *réduits* from which all the trenches and communications are commanded with rifle fire. The passages which are left open between these groups must be carefully protected by cross-fire from the neighbouring works. The shelters for these groups and reserves of material for obstacles, etc., must be provided in peace-time.

Digitized by Google

But the increase of garrison is the most costly consequence of an increased perimeter. The garrison of a fortress is estimated by tripling, or sometimes by quadrupling, the number of men required for one relief of the outposts, which are established at 1 or 2 *versts* beyond the main fortress positions. On an average this works out at 1,000 men and 10 guns of fortress calibre per each lineal *verst* ($\frac{2}{3}$ mile) of fortress perimeter, but it depends to some extent on the size of the fortress reserve and that in turn depends on the special importance which is attached to the fortress in an *active* sense.

No practicable increase of perimeter will, independently of local conditions, protect the fortress artillery from enfilade fire, and this must be met by concealment, traverses, and the chequer-wise siting of batteries.

Having shown the importance of reducing the length of fortress perimeters, it is necessary to study the conditions which place a limit on such reduction. Fortresses must not be liable to simultaneous siege on all sides. They must also be large enough to allow of suitable length in the fronts which are attacked. A length of front of from 6 to 7 *versts* would meet the case, allowing for the deployment of 300 to 400 guns, and a corresponding force of infantry. Finally within this length of front there must be a fairly wide space safe from well-directed reverse fire, which with siege artillery must be considered to have a range of 8 *versts*. To satisfy these conditions a perimeter with radius of 5 *versts* would seem to be the irreducible minimum.

But every fortress design must be governed entirely by local conditions. There must be good infantry positions, and in rear of them well-covered and ample spaces for the siting of the fortress batteries; communications with the rear should be well concealed, and there must be natural observation points for the defenders, and an absence of such for the possible besiegers. A regular circular design is difficult to apply to the ground, and always leads to extravagant extension in order to satisfy purely military requirements.

These considerations have led to the discussion of a possible solution in the direction of group designs, and the author mentions for the sake of criticism two schemes of circular fortresses, in both of which the perimeter is divided up into groups of about $3\frac{1}{2}$ *versts* in extent, with intervals between them of about 6 *versts*.

In order to criticize and appreciate the value of the proposed systems, they must be analysed from a purely tactical point of view, by considering the operations which can be directed against them.

For capturing a fortress two methods may be used, either separately or in combination, open assault and a regular siege. Until recently the former was greatly in favour with the Germans, but they are now beginning to look upon it as risky and hardly to be recommended as an independent operation.

The regulation method of assault on a fort contemplates a numerical superiority of the attack over the defence of 16 to 1.

It would not be difficult to show that an open assault upon one of the groups of a fortress of group design, even if made with this superiority of numbers, would have little chance of success, owing to the heavy artillery

Digitized by Google

fire which could be brought to bear upon it from the group itself, from the neighbouring groups and from the central enclosure. The best scene for the counter-attack is the ground in rear of the group, and consequently the intervals between groups should be kept free from detached works of all kinds, which could be seized by the assaulting troops, and used by them in covering their retirement, or in strengthening their outpost line in preparation for the siege which would inevitably follow upon an abortive assault.

Turning now to a regular siege as at present designed against fortresses with continuous lines, the investing troops would occupy a zone extending from 4 to 8 kilometres beyond these lines. It is estimated that a division of these troops would occupy from 12 to 13 kilometres of the perimeter of the investment, except on the sides selected for attack, and in these it would occupy not more than 6 kilometres. Owing to the importance of maintaining connection in *depth*, which is recognized in fortress as in field warfare, each unit would have its independent line of advance, and only at the foot of the glacis would the regiments of a brigade occupy a common trench. The gaps between these separate lines of attack are useful as facilitating the rapid advance of assaulting columns. Where the forts are situated at intervals of $1\frac{1}{2}$ kilometres, each brigade would attack one fort and the half-intervals on each side of it.

There would probably be two attacks, a main attack carried out by three divisions, and a subsidiary one carried out by one or two divisions. The total length of front attacked by the one or two separate attacks will be about 10 to 15 *versts*.

If this system is applied to the proposed schemes of group design, it will be seen that in a regular siege one attack would probably embrace two groups and the interval between them. This would necessitate the deployment of artillery, and consequently of infantry also, continuously across the interval between the groups in hastily prepared positions, and the result would be a line considerably weaker than in the present system of fortification. The groups must be large enough individually to receive the whole shock of a regular siege.

In designing fortresses it is well to keep in view the fact that wars are decided by the action of field armies, and that fortresses are only intended to facilitate the action of these armies. They should therefore adapt themselves to the manœuvring of the armies around them, or to the passage of the armies through them, and for their own defence they should require the smallest possible number of men and guns.

At the same time so important is *active* action even in defence, that fortress works should be so constructed and sited that every increase of garrison or armament beyond the minimum necessary for passive defence may be placed to the advantage of active defence in a greater and greater degree, even up to the point of taking the offensive and breaking the blockade.

These requirements can only be satisfied in a fortress of group design, in which the intervals between groups are free of works and suited to the action and manœuvring of field troops.

The groups must be proof against assault and adapted individually to

Digitized by Google

resist a siege. They must be fully self-contained, and will differ only from small fortresses in that their flanks and rear are protected by the fire of neighbouring groups.

Any excess of garrison, beyond that required for holding the groups, adds to the active properties of the fortress and to its influence on the surrounding neighbourhood. In opposing an assault, even the smallest excess would be able to operate in the ground between groups or central enclosure, which would create for it exceptionally favourable tactical conditions, and would form an outside reserve to the groups, or a general fortress reserve, with which activity could be given to the defence. At the same time everything is ready for a siege, and no supplementary works have to be made at the last moment outside the groups, as part of the normal scheme of defence. In this case if there is an excess of garrison advanced positions can be occupied and entrenched, existing positions can be extended, and the siege works of the attack may even themselves be attacked by counter-approaches from the flanks. Sevastopol gives a brilliant example of active defence made possible by an excess of garrison.

The actual size of each group can only be decided by the ground, but fronts liable to attack will be longer than those which from their position or by the nature of their surroundings are not so liable. The designing of a fortress is reduced to choosing round the selected point (river or road crossing, etc.) a series of positions similar to those chosen in field warfare. The tracts of country included in these positions must be of sufficient extent to allow of the deployment of all means necessary for their defence, and they must be surrounded by perimeter fortifications, for protection against assault. Their fronts must be prepared to resist both assault and siege, and their flanks and gorges assault only. The intervals between them are limited by the effective range of modern fortress artillery, and must not exceed 5 to 7 *versts*. The whole extent of these intervals must be under observation from stations within the groups, and a thorough system of buried telephone communications must allow of information obtained in the observation of fire being passed from one group to another, and thus reduce considerably the distances to be observed. If, owing to the nature of the ground, a group has to be moved so far to the front, or to a flank, as to be out of reach of support from neighbouring groups or from the central enclosure, a permanent work in the nature of a miniature group must be interpolated to maintain connection.

The proposed system is peculiarly applicable to any kind of ground, and it has the advantage of not being bound down to any particular radius of perimeter. Without material increase in garrison or armament it can be extended considerably further afield than the existing systems. This quality is especially valuable when the central enclosure contains objects which cannot be protected under casemates, such as a fleet, factories or workshops.

Plate I. shows an example of the author's proposals for the fortification of a modern fortress. The point selected for defence is a railway junction and river crossing, lying in a basin, and surrounded on three sides by hills, on which the main positions will naturally rest. It is further

Digitized by Google

assumed that strategic conditions make a regular siege probable from the north and east, possible from the west and impossible from the south.

Groups I., II. and III. are independent fortress positions, capable of deploying and siting within themselves sufficient equipment for opposing a siege of a fortress, including primarily a sufficient quantity of fortress artillery.

Groups IV. and V., on sides not liable to regular siege, are mainly artillery groups protected against assault. No. VII. is subsidiary, and also mainly an artillery group, and No. VI. is a central enclosure of normal type.

Plate II. gives an example of the modern German method of fortifying a length of front liable to regular siege, applicable to the lengths lettered A—B in *Plate* I.

In a fortress of group design the batteries containing the guns of the permanent armament will be chiefly concentrated on the flanks of the group, in order to develop an especially heavy fire on the intervals. Some of the guns are mounted in casemates and caponiers, but the majority will be in turrets in order to secure the advantage of all-round fire.

Some batteries of the permanent armament and also some of long-range quick-firing guns must be placed in the central enclosure. These also require all-round fire and should be mounted in open masked turret batteries.

The gorges of the groups must be closed by lines of obstacles, flanked from defensive works of special design, which are sited at intervals of not more than 1 *verst*. These works would consist of bombproof barracks adapted for infantry defence, and can be utilized to cover the entrances to the barracks and shelters prepared for the group reserve, and to protect the 2nd line magazines, group supply stores, etc., which would be sited in or near them. The bombproof barracks are intended for the off-duty reliefs of gunners and sappers.

In Groups I. and III. one or two 2nd line forts are added to command the interior of the groups, where local conditions or too great depth render this necessary.

All stores and reserve armament must be collected within the groups and central enclosure, so that the remainder of the fortress area may contain nothing that the enemy can damage during a temporary occupation. If it is necessary to have any structure with a military value, such as a bridge, outside the group area, it must be protected by some special work such as a 2nd line fort, with a system of obstacles under fire from some fort or defensible barrack.

The fortress communications are arranged in the usual manner, circular and radial along the whole perimeter, the radial roads and railways being placed in rear of groups.

The whole fortress area must be thickly masked by plantations. It is best to make them in belts 35 to 70 ft. in width, aligned between pairs of strong points or observation stations. In this way their edges will always be under observation, and they will serve as screens without affording

Digitized by Google

cover to the enemy. Similar plantations may also be placed in front of the fortress positions. In war time they can be cut down to form abattis or they may be left to mask front positions or even counter-approaches. Lastly a fortress of this description must be abundantly equipped with searchlights. The fronts of the intervals between groups must be lighted permanently by fixed lights, and the interior part of these intervals intermittently by movable lights from within the groups. These latter will be additional to the lights intended for use in opposing assaults, which are also intermittent.

In the scheme of group fortification shown in *Plate* I. the radius of perimeter averages 12 *versts* and the total area included in the fortress reaches 400 square *versts*; of this area however only 130 square *versts* are actually occupied, which is equivalent to a circular area of normal type with a radius of 6 to 7 *versts*.

F. E. G. Skey.

Digitized by Google

TABLE OF ARMAMENT OF FORTRESS OF GROUP DESIGN SHOWN IN *Plate* I.

No. of Group.	Work.	Howitzers.				Guns.					Machine Guns.	Total of Guns.			Total Machine Guns.	Remarks.
		27 c.m. and Greater.	21 c.m.	15 c.m.	Field.	15 c.m.	10½ c.m.	Field.	For Opposing Storming Parties.	For Flanking Defence of Ditches.		Fortress.	Field and Smaller.	Total.		
I.	4 forts	—	—	—	—	—	—	24[1]	24	32	32	—	80	152	116	I. [1] Averaging 3 in each interval demi-caponier. Total 6 in each fort. [2] 8 in each. [3] 4 in each. [4] Averaging 2 in each interval caponier in fort. [5] 2 in each. [6] 6 in each. [7] At 4 per verst of front and 16 per verst of flank. Total 4 × 9 + 16 × 3 = 84 guns. [8] At 25 guns per verst of front (15 fortress and 10 field). Total 25 × 8 = 200. [9] Total per note [7] = 4 × 13 + 16 × 3 = 100 guns. [10] Total per note [8] = 25 × 9 = 225 guns. [11] Total per note [7] = 4 × 16 + 16 × 6 = 160 guns. [12] Total per note [8] = 25 × 9 = 225 guns. [13] Spare guns are not included in this table.
	5 interval and 1 2nd line forts ...	—	—	—	—	—	—	12[4]	12[5]	36	48	—	60			
	6 rear strong points	—	—	—	—	—	—	—	12[5]	—	36	—	12			
	Permanent armament of intervals [2]	4	—	20	—	35	25	—	—	—	—	84	—	84		
	Group reserve [8]	—	—	80	20	—	40	60	—	—	—	120	80	200		
II.	5 forts	—	—	—	—	—	—	30[1]	30[6]	40	40[2]	—	100	172	124	
	6 interval forts	—	—	—	—	—	—	12[4]	12[5]	36[6]	48[2]	—	60			
	6 rear strong points	—	—	—	—	—	—	—	12[5]	—	36[6]	—	12			
	Permanent armament of intervals [7, 9]	4	—	26	—	40	30	—	—	—	—	100	—	100		
	Group reserve [8, 10]	—	—	80	20	—	50	70	—	—	—	135	90	225		
III.	7 forts	—	—	—	—	—	—	42[1]	42[6]	56	56[2]	—	140	238	174	
	6 interval and 2 2nd line forts ...	—	—	—	—	—	—	16[4]	16[5]	48[6]	64[2]	—	80			
	9 rear strong points	—	—	—	—	—	—	—	18	—	54[6]	—	18			
	Permanent armament of intervals [7, 11]	6	—	34	—	70	50	—	—	—	—	160	—	160		
	Group reserve [8, 12]	—	—	80	30	—	55	60	—	—	—	135	90	225		
IV.	1 fort	—	—	—	—	—	—	8	6	8	8	—	22	26	20	
	2 rear strong points	—	—	—	—	—	—	—	4[5]	—	12[6]	—	4			
	Permanent armament of groups ...	—	—	6	—	10	10	—	—	—	—	26	—	26		
	Group reserve	—	—	—	—	—	—	8	—	—	—	—	8	8		
V.	1 fort	—	—	—	—	—	—	8	6	8	8	—	22			
	2 interval forts	—	—	—	—	—	—	8[3]	4[5]	12[6]	12[6]	—	24	48	26	
	1 rear strong point	—	—	—	—	—	—	—	2	—	6	—	2			
	Permanent armament of group ...	—	—	6	—	16	12	—	—	—	—	34	—	34		
	Group reserve	—	—	—	—	—	—	12	—	—	—	—	—	12		
VII.	1 fort	—	—	—	—	—	—	8	6	8	8	—	22	26	20	
	2 rear strong points	—	—	—	—	—	—	—	4[5]	—	12[6]	—	4			
	Permanent armament of group ...	—	—	6	—	10	10	8	—	—	—	26	8	34		
VI.	8 forts	—	—	—	—	—	—	—	16[5]	48[6]	48[6]	—	64	64	48	
	Permanent armament of group ...	4	—	—	—	30	20	—	—	—	—	54	—	54	—	
	Forts, etc., for guarding bridges ..	—	—	—	—	—	—	—	8	12	18	—	20	20	18	
	Total	18	—	338	70	211	307	386	234	344	546	874	1034	1908	546	
	General reserve ..	—	20	100	—	40	40	—	—	—	—	200	—	200	—	
	Grand Total..											1074	1034	2108	546	

Digitized by Google

REVIEWS.

THE CIVIL ENGINEER'S COST BOOK.

By MAJOR T. E. COLEMAN, Staff for R.E. Services.—(E. & F. Spon. 5s.).

THIS is a little book which should be of great use to any R.E. officer who may have to execute, or report on the advisability or possibility of executing work beyond that usually met with in a division. The author has compressed the most varied information on all engineering subjects—from dry docks to disconnecting manholes—into 289 pages 4″ × 6″, giving the approximate cost of each per unit of length, weight, etc.; and—what is probably of greater value—the actual cost of works executed in various parts of the world. Unfortunately in the latter case the dates are often omitted, and it may be hoped that they will be inserted in subsequent editions.

The section on Reinforced Concrete is particularly full and good, but very scanty details are given for steel-framed buildings and roofs, though iron roofs are fully dealt with. It seems of little use to give the cost of the old Charing Cross Station roof, which collapsed in 1905! Another subject which might be treated in subsequent editions is that of earth dams.

On the whole, it is a book which should certainly find a place on the D.O.'s table, alongside the same author's "Approximate Estimates."

C.R.S.

THE RUINS OF MEXICO.

By CONSTANTINE GEO. RICKARDS, Oxaca, Mexico.—(H. E. Shrimpton, 105, Regent Street, W. £2 2s. 0d.).

THIS work treats of the ruins in the States of Chiapas, Yucatán, Tabasco, Oxaca and Puebla, the text giving tersely the facts about the wonderful antiquities of Mexico. There are 260 collotype plates in the volume, and these give a clear insight into the marvellous features of ancient Mexican architecture. The author says that his object in presenting the work "is to induce those who take a real interest in archæology to dive into and study the many good works that have been written on Mexican antiquitities." Mr. Rickards' volume should have that effect, for of itself it is fascinating and it should induce the student to go further. The excellence of the workmanship of the production deserves all praise.

Digitized by Google

NOTICES OF MAGAZINES.

REVUE MILITAIRE DES ARMÉES ÉTRANGÈRES.

November, 1911.

REORGANIZATION OF THE OTTOMAN ARMY.—A radical change has just been effected in the Turkish Army, under the influence of the Chief of the General Staff, Izzet Pascha. It consists in the adoption of the ternary formation, or formation by threes. The objects of the reform are to modify the organization of the commands, to prepare the methodical increase of the military forces, and their better tactical employment. The "ternary formation" consists in the adoption of army corps of "nizam" (active troops) each of three divisions, subdivided into three infantry regiments of three battalions each. The division also possesses a battalion of rifles, a squadron, a regiment of artillery, a supply column with three days rations and a sanitary formation. The corps troops also comprise unallotted units of rifles, cavalry, artillery, engineers, ambulance and A.S.C. As regards the "redif" or reserve formations, the divisions will be similarly organized, but the number of battalions will not be necessarily fixed at nine. It will be larger or smaller according to the geographical features of the district from which the division is recruited. The nizam and redif formations will be grouped in "ordus" or inspections, which correspond geographically to theatres of operations, *e.g.* Macedonia, Thrace, Armenia, Mesopotamia. The ordu is commanded by an inspector-general, who is assisted by an inspector of redif formations, and an inspector-general of artillery in each ordu. Previous to this reorganization, ordu commanders had forces under their command which were so large as to be unwieldy. The reorganization therefore ensures the better commanding of the Turkish Army in time of peace as well as in time of war. Since 1854, the strength of the Turkish Army has increased from 168 to 527 battalions. Up to 1907, this increase was gradual, it was then noticed that a slight numerical retrograde movement was taking place, and it was found necessary to grant to Christians, as well as to Moslems, the privilege of bearing arms; at the present moment, there are up to 25 per cent. of Christians in every regiment, but this proportion will gradually increase as public opinion gets accustomed to the idea of several religions in the army.

Turkey is now divided into military districts as follows:—

1st Ordu.—Constantinople, including Thrace, and extending into Asia Minor from the Black Sea to the south of the Constantinople-Afioum-Kara-Hisar-Boulgourlou Railway, which belongs to this district and touches at the Head Quarters of a large number of the redif divisions of the command.

2nd Ordu.—Saloniki, including Macedonia, and extending into Asia Minor into the region of Smyrna and stretching into Syria. Railways also connect up the Head Quarters of most of the divisions of this command.

3rd Ordu.—Erzindjian, including Armenia.

4th Ordu.—Baghdad, including Mesopotamia and Chaldea.

Digitized by Google

Besides these four ordus, there are a certain number of indepe formations :—An army corps of active troops consisting of three divisions ; a regiment of rifles of three battalions; a cavalry brigade of two or three regiments; corps artillery, including if possible two groups of three batteries each of mountain artillery, and a group of 6″ howitzers ; a sapper battalion; a bridging train ; a telegraph company ; a train battalion, which supplies an A.S.C. company to each of the three divisions of the corps ; an ambulance company and four field hospitals. Besides all these troops there are left the troops of the active army employed in fortresses or on coastal works, two battalions of railway troops and 65 regiments of irregular cavalry. The reorganization of the Turkish Army on the "ternary" principle is an excellent step, it modifies its organization, and is likely to increase the efficiency of the whole army.

Foreign News from Divers Countries.—*Austria.*—In view of the increased importance of communication in the field, the creation of a regiment of telegraphists has been decided upon. The regiment is at present largely a cadre formation, including four battalions, each having a school of telegraphy and also of an experimental section and a wireless section.

Spain.—The old corps of military administration has been abolished and replaced by two others, the "intendance" department, corresponding to our A.S.C., *i.e.* having charge of supplies, buildings, remount establishments, both in barracks and in the field, and an audit corps. The officers for the "intendance" department will be educated at a special military academy, based on the same principles as the military academies from which officers for the other arms are drawn, and this department will also find paymasters.

Russia.—An air committee has been created which is attached to the direction of engineers. It includes :—(*a*). A president chosen from the engineer committee. (*b*). Permanent members,—the principal members of the air section and the officer in charge of workshops, the commandant of the school of aviation, the commandant of the air battalion. (*c*). Consulting members,—an artillery officer, a general staff officer, a mechanical engineer of the corps of engineers, a representative of the navy. (*d*). Besides the committee has the right to call in outside people who are known to be experts on any question which it may happen to be studying at the time. The duties of the committee are :—(1). To examine inventions and investigate all matters relating to the question of aeronautics in as far as their usefulness to the army is concerned. (2). To examine models and sketches which accompany demands for materials for the technical air troops. (3). To examine the training programmes of the air troops. (4). To follow the development of aeronautical science in Russia and abroad. Arrangements are being made to carry out at every summer training combined exercises of all the various M.G. detachments in divisions and army corps. This training will last 15 days and will include a detailed inspection of the material and methods of training the *personnel;* field firing, both with and without accompanying infantry or cavalry ; and a shooting competition. The director of the exercise will be a general officer, a brigade commander in the case of the massed M.G.'s of a division, and a divisional commander in the case of the massed guns of an army corps.

A. H. Scott.

Digitized by Google

RIVISTA DI ARTIGLIERIA E GENIO.

February, 1912.

SIEGE WARFARE.—The February number of the above-mentioned Journal publishes a long and very able article by Major De Antoni of the Engineers, from which a few extracts are given.

Organization and Conduct of the Defence.—As we are not able to study the operation of siege warfare before defining the particular character of the places against which the attacks are directed, it is necessary to assume certain points relating to the strong fortified places built in non-mountainous country.

In new works of fortification, owing to the incessant progress in the methods of attack, the principal materials used in their construction are cement, iron, and steel.

The type of modern forts, always casemated, and open to the sky, like that of the preceding epoch, consists of a nucleus, more or less large, of cemented works, undistinguishable from the surrounding ground, in which nuclei, in varying numbers and designs, are the fixed armoured casemates, the towers, and the revolving turrets containing the artillery.

The massive works of former times are reduced in number, and have assumed the character of strong heavily armed works as bases; while the large intervals are defended by a few permanent forts, and many occasional batteries constructed at the moment of arranging the defences. A modern fortified place on a war footing should comprise the following: (*a*), the body of the place—nucleus—enclosed or not; (*b*), a line of principal forts, distant from 6 to 8 k.m. from the nucleus; (*c*), occasional batteries placed at intervals between the forts; (*d*), a line of advanced positions—fortified and mobilized during the war—at a distance of from 2 to 4 k.m. beyond the line of principal forts; (*e*), a zone of distant positions, guarding the easiest and most probable lines of advance of the assailants, at distances varying with the nature of the ground (on an average about 10 or 12 k.m. from the advanced posts). Except in special cases, fortified places in times of peace should be prepared only with the principal lines of defence, while the other elements of defence should be organized at the time of putting the place in a state of defence.

The *armament* for the permanent works of the place which is kept ready in peace time, is called that of *security*, and that provided for the batteries at intervals and the complementary works is called *reserve* armament.

The *garrison* comprises:—(1). The *garrison of security*—which is kept sufficient against surprise attacks or those of *viva forza*; (2), the *defensive garrison*—which is formed from the *garrison of security* plus the *mobile reserve* of the place composed of organized detachments—divisions or army corps—of the mobilized army, and the technical troops of artillery and engineers.

During the state of siege the *defensive garrison* is subdivided into (*a*), *the general reserve*—with reserves of artillery and engineers; (*b*), the *troops for the sectors*; (*c*), the *fort troops*. The *general reserve* comprises one or two nuclei of infantry troops and other arms, at the exclusive disposition of the commandant of the place.

The *troops for the section* provide for the service of the advanced posts maintaining a reserve.

Digitized by Google

The following may be retained for the formation of the garrison —(*a*), For the garrison of security:—(1). *Infantry*: From one to two companies for the principal forts; from one-half to one company for the secondary works; one battalion—with field artillery and mitrailleuses—for each interval of extension of 2 to 4 k.m.; some battalions in general reserve, according to the probable direction of the attack. (2). *Troops of artillery and engineers as required.* (3). *Very few cavalry.* (*b*), For the defensive garrison, a widely approximate estimate *of one man per lineal metre of the line of circumference.*

II.

Siege Operations.—The attack of a place may be attempted by rapid attacks—such as surprises, and the attack *di viva forza*—or by prepared attacks—such as bombardment by artillery of medium calibre, the blockade, or the regular siege.

Surprises.—The attack by surprise will seldom succeed unless it is conducted against places badly defended, incomplete, and badly garrisoned.

Against strong modern forts, the surprise attack is destined to failure unless it is undertaken with overwhelming forces at the commencement of hostilities, when the arrangements for the defence of the place are not yet completed.

It is impossible to give definite rules for surprise attacks on a fortified position, because the conduct of the attack will be greatly influenced by local conditions; but it is of course necessary to procure by means of careful reconnaissances exact information as to the place to be attacked.

After examining with care all the obstacles that the several columns of assault are likely to meet with, detachments of engineers should be told off to precede the various detachments of the attack. To these, special tools and materials should be distributed as follows: (*a*), To a group of men at the most advanced point, explosive shells to throw at all the accessory defences, either in the ditches, in the surrounding roads, or in the interior of the flanking casemates; (*b*), to a second group, that will follow immediately after the first, the material for the crossing of the ditch, and scaling ladders; (*c*), to a third group, a large supply of tools and material for defensive purposes, for the purpose of rapidly clearing the zone of the attack. Each detachment should have a well-determined object; in all cases the operation should be completed with celerity and with the greatest vigour.

The Attack "di viva forza."—This form of attack may be attempted with some probability of success against strong forts, surprised during the period of preparation, and before the system of defence is completely organized.

General Von Sauers is in favour of it, on the grounds that at no moment is a fortified place less able to resist such an attack than at the commencement of the investment; and that all the time employed by the attack in slow siege operations, affords facilities to the besieged for obtaining reinforcements and increasing the difficulties for the besiegers; and he seems to be in favour of a vigorous and decisive attack before such difficulties have accumulated.

On the other hand the difficulties of this form of attack are confirmed by the history of sieges, and especially by that of Port Arthur during which the attack on Von Sauer's system was repeatedly attempted without favourable, results. The first general attack upon the advanced line of the works,

Digitized by Google

commenced on the 18th August, had to be suspended without having obtained any sensible advantages, in spite of the loss of 14,000 men.

Again the attack made upon the works on the 19th September—when it was believed that the defences had suffered from bombardments—led to immense losses without result.

General Langlois in some conferences held in Paris in 1906 and recorded in his book: *La guerre possible*, observes that the violent attack, which he styles "brusquée," should be developed on the following lines:—"With an army of several corps, provided with complete mobile siege parks, which might push back the defences on the line of forts, this operation may succeed but with a considerable sacrifice of men and ammunition.

"This advantage obtained, siege batteries may be established at once before all the lines of circumference, and on the front selected for the decisive attack if cover can be obtained.

"During these operations, which will occupy days and not hours, a great quantity of ammunition must be collected for the batteries, and when all is ready, the place may be bombarded with a vigorous and unrelenting fire and the infantry are hurled forward to the attack."

Great preparation is required for this form of attack which will last for days and perhaps for some weeks, according to the railway power that can transport the parks and ammunition from the lines and bases to the siege batteries.

The author divides his article under the following headings:—(1), The attack by surprise; (2), the attack "*di viva forza*"; (3), the bombardment; (4), the blockade; (5), the regular siege.

All these methods of attack are fully and lucidly described.

The duties of the Commanding Engineer are thus enumerated:—

To execute the necessary works of fortification;

To arrange for the obstacles in front of the lines;

To put in practice demolitions, or means of destruction for impeding the advance of the enemy;

To increase the communication by easy junction and connecting roads;

To post up indicating tables assigning to the troops the various ways of access to the places of combat;

To prepare bridges over the water courses at convenient points and to repair such as have been broken by the enemy;

To arrange for inundations whenever they may be possible and opportune;

To arrange for permanent observatories.

In conclusion the author sums up that, where the place is well organized, where there is no want of provisions, arms or ammunition, and where there is an arduous defence conducted by an able and intelligent commander, it is impossible to set limits of time to the period of the operations, because we cannot estimate the physical forces that have to be considered.

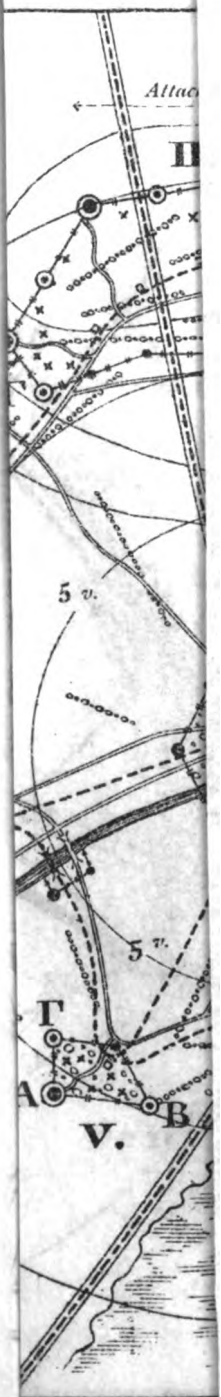
But now indeed siege warfare as well as that of the field differs entirely from what it was in the glorious days of Vauban and the old deliberate and systematic operations of attack and defence, and consists rather of the strife of men, of minds, and characters, which refuse to be fettered by fixed and unalterable laws.

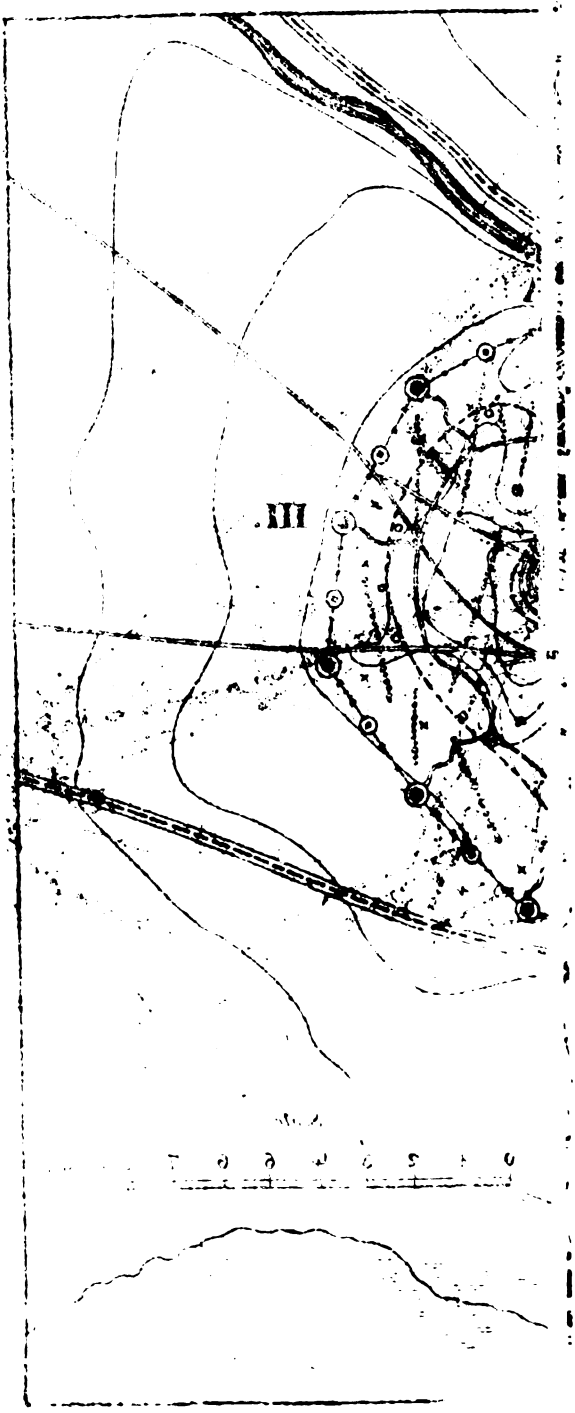
E. T. THACKERAY.

Digitized by Google

OF FO

ME OF A





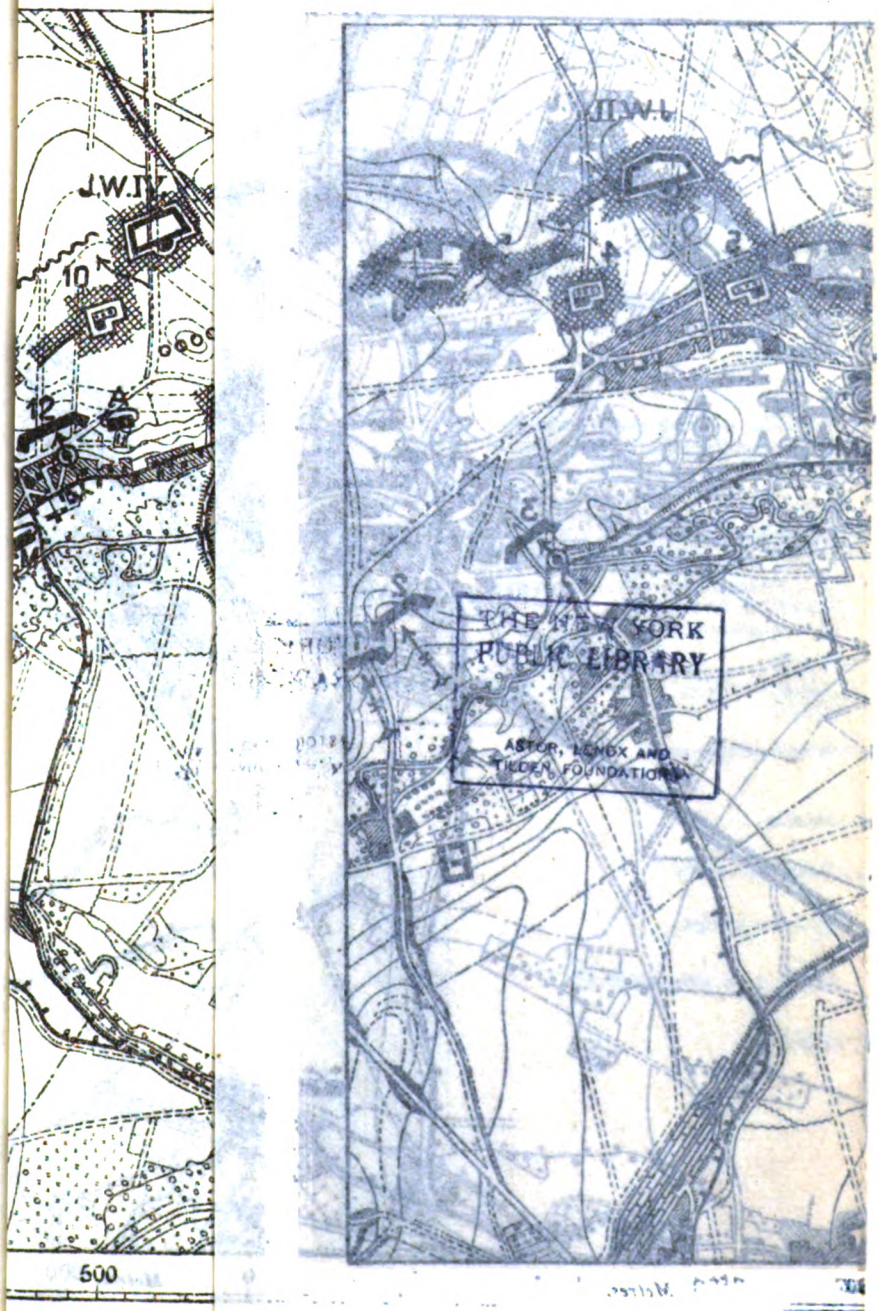
Digitized by Google

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

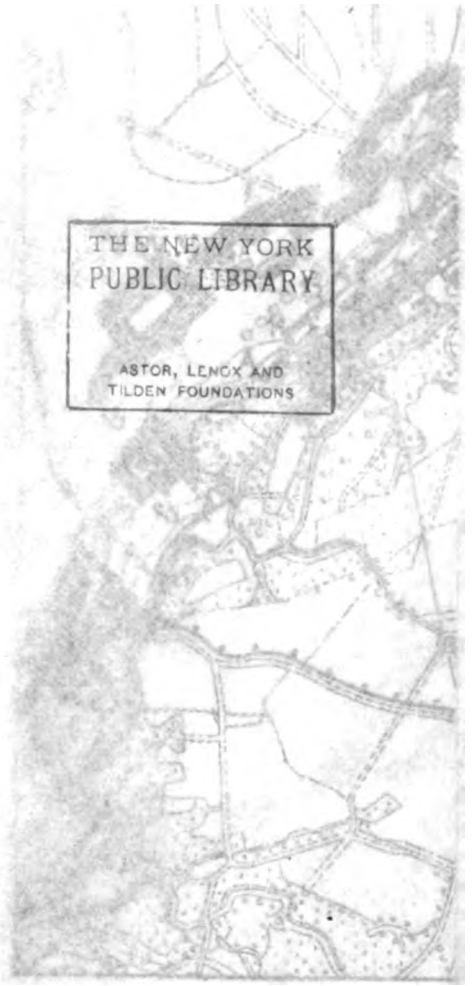
M OF F

THE ATTA



THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

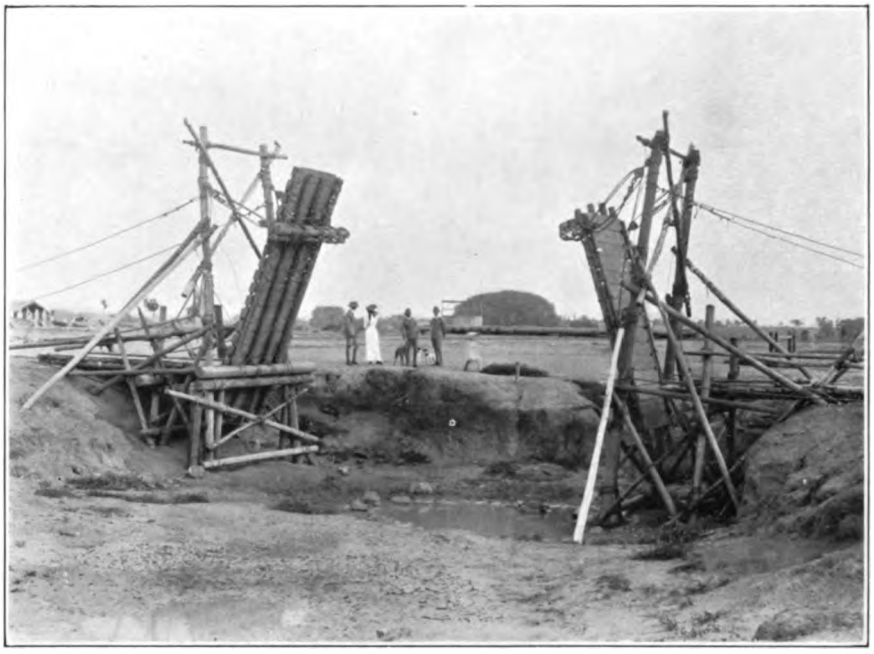
Digitized by Google

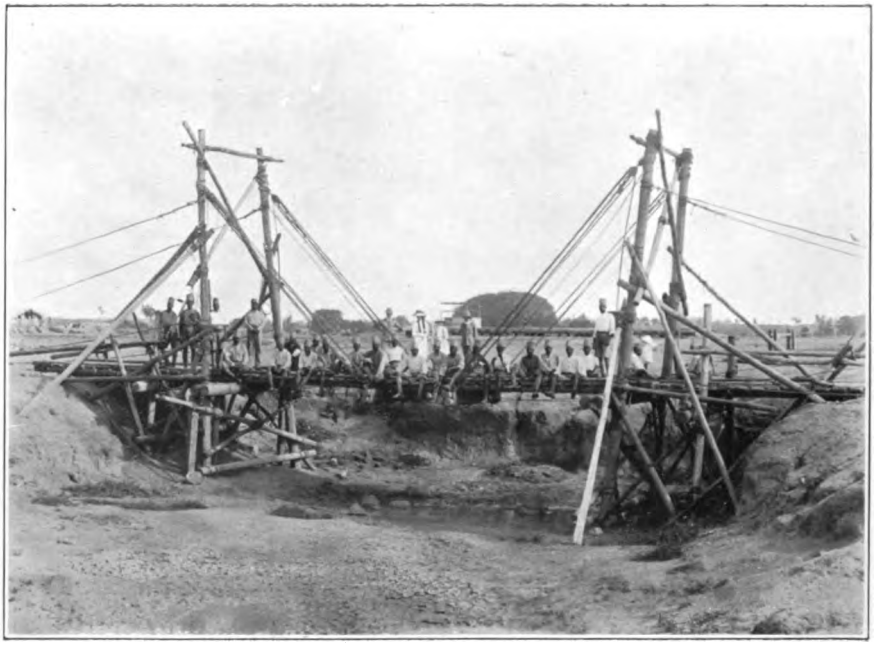

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

Digitized by Google

A FIELD DRAWBRIDGE.





Digitized by Google

A FIELD DRAWBRIDGE.

By Capt. E. K. Molesworth, R.E.

During the annual fieldworks course of the 13th (Field) Company, "Q.V.O." S. & M., I was asked to construct the ingenious drawbridge described by Major Wilson in the *R.E. Journal* for April, 1912. As it appeared that the number of tackles required was considerably more than a Field Company of Sappers would carry on service, a somewhat simpler type of drawbridge was designed and constructed, and it answered the purpose excellently.

The accompanying photos (see *Plate*) show the details so clearly, that a long description is unnecessary.

The bridge was designed to give a 30-ft. opening, and to be capable of being opened or closed in a minute or two. It carried infantry in fours.

The two tall frames were 28 ft. high and were well braced; the bays immediately in rear of them had a span of only 5 ft.

The movable bays were each 18 ft. long, 15 ft. of this length projecting in front of the tall frame and 15 ft. behind it. The roadbearers were lashed to a transom capable of revolving round the transom of the tall frame, and the bays were easily raised in about one minute by two double blocks near their front extremities, the returns passing through snatch blocks lashed at a convenient height to the legs of the frames.

As the lashings rub round the transoms when the bridge is raised or lowered, they will wear out in time, and it will be advisable therefore to countersink them. No signs of wear appeared, however, in the present instance after the bridge had been raised some twenty times. Plenty of grease is necessary on the revolving parts.

It was found that the movable transom had to be prevented from riding close up to the leg of the frame, for, when it got into this position, it revolved on its own axis when the bay was lowered, instead of rolling down the other transom. This was easily prevented by moving forward the horizontal struts (shown in the *Plate*) a couple of inches. The transoms must be absolutely horizontal, and cylindrical, or else there will be a tendency to creep sideways. All lashings must be very tight, and each chess should have a nail behind it, as no slipping must be allowed when the bridge is being raised.

Digitized by Google

As the bay is very nearly balanced when fully raised, a couple of foot-ropes are necessary at its rear end to give the necessary start downwards for lowering. For the same reason a good counter-weight is necessary on the front end. If the roadbearers overlap a little, no false bay is required; and to raise the bridge, there is nothing whatever to be done but haul on the tackles. Steel guys relieved the tackles of the weight when the bridge was horizontal.

The roadway was stiff enough, and the lateral stiffness was obtained by diagonal bracing with telegraph wire.

The bridge was simple to make, worked most efficiently and required only such stores as would probably be available.

Digitized by Google

THE INFLUENCE OF HIGH GROUND IN DEFENCE.

By D.O.L.F.

It is now recognized that the adoption of the tactical offensive is the surest road to decisive success in war; yet it will often be necessary, for good strategical reasons, that some portion of a force should occupy a defensive position. In selecting such a position, especially when doing so from a map, it is natural to look for a well-defined line of high ground, if strategical conditions permit of any choice. It is open to question, however, whether this is sound under modern conditions of warfare.

For instance suppose that a hostile force, moving north, is to be checked somewhere between Aldershot and Guildford. The Hog's Back at once suggests itself as a suitable line, but might not the line of the Wey or one between the two be as good or better?

The respective advantages and disadvantages of high or low sites for trenches in a defensive position are briefly discussed in *F.S.R.*, I., p. 125, but on the broader question of how far high ground generally is suitable for defence little is to be found.

We are told however (*F.S.R.*, I., 108, 3) that "the influence of ground must be one of the first considerations in selecting a position."

What then is the influence of commanding ground under modern conditions?

Until recently such ground has been regarded as almost a necessity for the defence. For example the occupation by the Boers of the line of the Modder River on November 28th, 1899, came as a surprise to many in Lord Methuen's force who expected that they would make their next stand in the hills near Spytfontein.

Before the introduction of firearms high sites for defence works may be said to have had no disadvantages and many advantages. These were:—

(i.). All approaches could be watched.
(ii.). Ground inside the work or the front line was hidden from the enemy's view.
(iii.). The possession of such positions denied them to the enemy.
(iv.). The enemy had to attack uphill, so that the defence had a great advantage in the use of both missiles and other weapons.
(v.). The moral effect of being above the enemy was considerable.

Digitized by Google

As however firearms developed these advantages became less marked and certain disadvantages appeared.

Its value for purposes of observation still exists; further, modern weapons make it possible to hit an enemy whenever seen so that the importance of seeing him has increased.

The development of aircraft is reducing the value of high ground as a screen and lessens its importance to an enemy for reconnaissance.

As regards actual fighting as the range of artillery increased it became more effective against a target on high ground. Then it began to be realized that the effects of its fire could best be avoided by resorting to concealment. This was not possible to any great extent before the invention of smokeless powder as the smoke would give away a position naturally inconspicuous. Now however such a site is eminently desirable and a high prominent one very much the reverse. The full value of the flat trajectory of the modern rifle is not obtained when the firing is downhill.

A steep slope below a work, in early times a great advantage to the defence, now favours the attack. It greatly facilitates the artillery support of an infantry assault, because the fire of the guns can be kept up to the last moment. The defenders have, unless provided with overhead cover, to expose themselves considerably in order to fire their rifles. The same is true in a greater degree of artillery which will often be altogether unable to cover the immediate front of a steep slope.

A position on high ground has a definiteness about it which has a certain moral value for the defence; it constitutes, however, a greater advantage to the attacker, especially if he is in a hurry as it facilitates the organization and general conduct of the attack; also the capture of one locality is more likely to be decisive than in the case of one on lower ground.

The facilities which high sites give for opening fire at long range are an important factor in a rear guard or similar action where the chief object is to delay the enemy. In the case of artillery, it is not necessary for the guns themselves to be high up as long as their fire can be observed and the result communicated to them.

The present advantages of high ground as a defensive position, then, may be said briefly to consist of

(i.). The facilities afforded for observing the enemy and the effect of the fire of the defence;

(ii.). The possibility of concealing troops behind such features; and

(iii.). The denying to the enemy the use of such localities.

Digitized by Google

These advantages are likely to be minimized as the development of aircraft proceeds.

The disadvantages, on the other hand, are

(i.). A good target is given to the enemy.
(ii.). Such a position is clearly defined, and this assists the attackers.
(iii.). The slope up to the position favours the attack.
(iv.). It is difficult to sweep the immediate front with artillery fire.

The Boers opposed to Lord Methuen in 1899 were quick to realize these disadvantages from their experiences at Belmont and Graspan. Accordingly at Modder River, Magersfontein, and subsequently Paardeberg, they occupied a very different class of position.

It would seem, then, that except in the case of a rear-guard action, a position on high ground is only advantageous on account of the facilities for observation which it confers.

Can this advantage be retained without incurring the disadvantages above mentioned? The best way is, doubtless, to occupy a line further forward so as to deny the high ground to the enemy. This can then be used for purposes of observation and for positions for some of the artillery; it will be of some use for screening movements in rear and will also be inaccessible to the enemy.

The main position should be far enough in front to give sufficient room for manœuvring the local reserves between it and the high ground. Such a position has many advantages. It will probably be inconspicuous owing to the background; there are usually spurs running out from higher ground which give good sites for "pivots," and facilities for their mutual support. The position is likely to be indefinite, that is to possess no "key" the loss of which will compromise the whole defence, or if there is one it is not likely to be easily recognizable by the enemy.

Para. 156–6, Field Artillery Training, approves of such a position as being likely to facilitate co-operation between the artillery and infantry defence, and in the case before mentioned it would appear that a suitable main line of defence could be found between the Hog's Back and the Wey.

Fig. 1, *R.E. Journal* for February, 1912, shows part of a position sited very much on the lines suggested above, possibly for similar reasons.

We may conclude then that, as a rule, a line of high ground is not in itself a suitable position for defence under modern conditions but may be very useful in rear of one on lower ground. Unless

Digitized by Google

there is a suitable position in front it will be better to disregard the attraction of the high ground and keep well away from it.

This conclusion is of course subject to many limitations as ground is of an infinite variety. One special case is that in which the high ground is the edge of a plateau; here a line well back from the crest will sometimes be satisfactory. Again if the country is very close, hill features have little or no influence unless the slopes are very steep. The same applies at night or in thick weather. Hence if much night fighting is to be expected there is still less to be gained by looking for a defensive position on high ground.

Digitized by Google

SOME ROYAL ENGINEER ORDERS AT THE SIEGE OF GIBRALTAR.

THE following interesting orders for the construction of batteries, etc., were issued at the commencement of the Great Siege of Gibraltar to Colonel (afterwards Sir W.) Green, the Chief Engineer. They formed part of a book which evidently contained the contemporary office copies of all orders issued by the Governor, and they are signed by his Secretary—J. Raleigh.

Most of the orders in the book are dated before the commencement of the Siege and are of no Corps interest. Some however are dated on the 26th of June and in July and were therefore issued after the Siege began as Mrs. Green in her journal mentions that the Governor attended by all the Colonels and Field Officers of the Garrison visited the Governor of St. Roque on the 19th June to congratulate him on his promotion to the rank of Lieut.-General, and that the blockade itself actually commenced on the 21st June.

The first set of orders for the construction of batteries, etc., was issued in February, 1779, in anticipation of the outbreak of hostilities, whilst the second and longer set are dated July 26th *i.e.* within a month of the Fortress being invested. Both sets of orders as well as the other documents transcribed have been purchased for the R.E. Museum.

(1).

Field Pay allotted the Engineers.

The Engineers doing duty in the Garrison having represented to me the customary authoriz'd allowance as Field Pay, when employed on actual service. This Fortress being at present Invested, I therefore do empower you to give your Orders to the Paymaster of the Ordnance to issue an additional allowance as Field Pay, agreeable to the undermention'd sums per day from

Colonel Green as Chief Engineer	£0	15	0
Capt. Phipps	0	7	6
Capt. Evelegh	0	7	0
Lieut. Booth	0	6	0
Lieut. Skinner	0	5	0
Lieut. Johnson	0	5	0
Lieut. Hay	0	5	0

Gibraltar, 25th June, 1779.

G. A. ELIOTT, *Govr.*

To Colonel GREEN, C.E. of the Garrison of Gibraltar.

Digitized by Google

(2).

THE RIGHT HON. G. A. ELIOTT, ETC.

You are hereby required and directed

To establish a Barbette Battery for two guns in the Demi Bastion of the upper Polygon of the South Front, with the proper Communications for Conducting on the Artillery.

To establish four platforms of Masonry for 13 Inch Sea Mortars—one at the Saluting Battery—one at Columbine's Battery—one on the South Bastion, and one upon the heights of Bona Vista.

To establish a Barbette Battery for four pieces of Artillery of a heavy nature and near the western extremity of the old Moorish Intrenchment.

To establish a Barbette Battery for two guns at the Devil's Bowling Green to flank and rake more effectually any Shipping or Boats endeavouring to approach or annoy our Batteries at the Back of the New Mole or Rosia Bay.

To carry on a path of communication through the Rocks round the high ground commencing at Bona Vista Guard Room, in such a manner as may most effectually preserve the commanding power that situation has over the flat ground called the Devil's Bowling Green.

To establish a Stone Bridge of communication with proper leading roads between Cumberland Battery and the Battery lately erected on Scud Hill.

To establish a Cannon Communication behind the Town from near Southport leading thro' the Moorish Castle into the King's and Princes' Lines.

To establish a Casemated Battery of one Gun, and to admit of two guns more over and contiguous to the arch, on a spot of ground to the Westward extremity of the Queen's Battery, now occupied by the Heirs of the late Mr. Crachet and to purchase from said Heirs a small building and other walls of inclosure their property, in order to admit of a communication to the said Battery which is intended to command all along that space of ground at the foot of the King's Line and the Inundation between the Glacis at Landport and the point of the Rock at the lower Forbes's. To blow and clear away at the foot of the Rock near Forbes's Guard, in order to render the access up into the Princes' Line more inaccessible by adding from 12 to 15 feet, or if possible from 15 to 20 feet in height (if time is allowed) to that part of the Rock.

To repair and reform an old Moorish Cistern under the Signal House, to save rain water to supply such works and repairs as may be carried on in that part of the mountain.

To clear out, repair and reform an old well which has been lately discovered in a favourable situation in the main street, to assist in preventing accidents by fire.

Digitized by Google

To Build an Officers' Guard Room in addition to the Non-Commissioned Officers' Guard Room in the cover'd way at Ragged Staff.

For the execution of which several works this shall be your sufficient warrant.

Given at Gibraltar the first day of February, 1779,

G. ELIOTT, *Govr.*

By the Governour's Command,
J.R., Secy.

(*To* Colonel GREEN, Chief Engineer).

(3).

Storekeepers' Pay Increased.

Colonel Green, Chief Engineer, and Colonel Godwin, Commanding Officer of Artillery, having represented to me that in the present situation of this Garrison, the Duty of Storekeeper to the Ordnance requires a more arduous and constant attendance, and is also become a far greater charge on the person who does that duty, and as it has been customary in Sieges for the Storekeeper, or Person doing that Duty, to receive Extra Pay on such particular occasions; I do therefore authorize Colonel Green and Colonel Godwin to give their orders to the Paymaster of the Ordnance to pay Mr. Samuel Cockcraft, Acting Storekeeper, the sum of Eight Shillings per diem from the date hereof.

Gibraltar, June 26th, 1779.

G. A. ELIOTT, *Govr.*

(4).

THE RIGHT HONBLE. G. A. ELIOTT, ETC.

Warrant for Erecting Sundry Batteries, etc.

Whereas this Garrison being now actually invested by the Spaniards both by sea and land, you are hereby required and directed

To erect the following Batteries along the edge of the Precipice from the Eastern Extremity of the Old Moorish Castle to the Rock Guard Room with their sufficient Cannon Communications.

A Battery of 3 Guns at the first Catalan Post.

A Battery of 4 Guns at the second Catalan Post, to reform the Queen's Battery at Willis's and to form an Embrasure for one Gun on the East Flank.

A Battery for 4 Guns *en barbette* immediately above and to the S.E. of the East Flank of the Queen's Battery.

To reform Farrington's Mortar Battery for 3 Guns *en barbette*, and the remaining part of about 80 feet in length to be duly prepar'd for the reception and service of Mortars.

Digitized by Google

To erect five Terrace Batteries for one Gun each on different levels along the edge of the precipice between Farrington's Battery and the North Lodgment.

A Battery for one Gun at the North Lodgment.

A Battery for 5 Guns under the Rock Guard about 900 feet above the level of the Isthmus, to be called Green's Lodge.

A Battery *en barbette* for three guns of a heavy nature, about 15 feet below the Rock Guard, with its communication 6 feet wide leading out of the Middle Hill road, 1,600 feet in length.

To establish 29 Lodgments for Marksmen with wall pieces on the edge of the precipice between the North Lodgment and the East Flank of Willis's.

To erect Batteries for 18 Guns with the necessary Epaulments along the wharf and jetties of the Navy Building Yard at the New Mole.

To repair, reform and augment such Batteries as may require it at Europa Point, and between that all along the Europa line wall to the Five Gun Battery included. Also to form such works and obstructions at the Pass of Europa upon the main road, and at the Pass of Bona Vista, leading from the Devil's Bowling Green, and may become most likely to contribute to our endeavours in preventing an Enemy's attempts to break through these passes.

To establish Lodgments, Palisades, Entrenchments, Flèches and Traverses of safety and precaution in the King's and Princes' Lines. Also temporary Traverses for the security of the communication along the Rampart of the Line Wall, the Streets of the Town and every other work exposed to the Northern attack.

To scarp, blow and quarry the Rock all along from the back of the Spur Guard Room at Landport to the Bluff point at Lower Forbes's to oppose an Enemy's attempts to break into the King's and Princes' Lines by way of a *coup de main* or surprize.

To prepare Chevaux de Frize, make Fascines, fill Sand Bags, deposit Battery Timber, intrenching tools and other necessary materials at the different posts and Batteries; to purchase timber of all kinds, Casks, Iron Hoops, Wool, Oakum, Hides, Cordage, Canvas and every material or Military Implement not in His Majesty's Stores that may be thought necessary for carrying on the present service on this particular occasion.

To form a work with a small rampart and parapet composed of a dry rubble walling and logg'd timber, framed and braced together and fill'd in with sand and stone rubbish, sufficiently high enough to become a Couvre port Flèche to the Drawbridge and entrance into the Covered Way at Ragged Staff from the Bay, as well as to protect and defend the several dead angles in this point of the Line Wall.

To repair, reform and augment the 1st Rosia Battery from two pieces of Artillery to six, particularly for the more effectual defence

Digitized by Google

of the bank of, and the access to the New Mole, and the South Front of the New Mole Fort.

To add a thickness of earth to the 20-inch parapet wall, and to be supported with Casks so as to form altogether a parapet of between 7 and 8 feet thick, with a Banquette 4 feet 6 inches broad and to sink the ground behind the Banquette $\overset{\text{F. I.}}{1\ 6}$ or 2 Feet, so as to gain a cover of $\overset{\text{F. I.}}{6\ 6}$ or 7 Feet from the fire of an Enemy's Fleet in the Bay, all along the Line Wall from Ragged Staff to the New Mole Fort.

To lay a Boom of obstruction across the Town Wharf, from the head of the Old Mole to the North-west angle of the Glacis at Landport, against the Enemy's attempts by boats upon the Old Mole and Waterport.

To pull down the steeples and such other remarkable objects as may invite or direct the Enemy's fire.

To erect and establish a work without the Ragged Staff Drawbridge as a Couvre port ; at the same time to protect and defend this Communication ; also the several re-entrant and dead angles in this quarter of the Line Wall.

To erect and establish a Lunette in the place of arms opposite the Navy Sally Port, between the Montagu and the Prince of Orange's Demi Bastion, for the more effectual defence of the adjacent branches of the Cover'd way, and the approach to the Beach, and all that Glacis between the back of the Old Mole and the Prince of Orange's Demi Bastion.

To cover the roof of the principal powder magazine in the Moorish Castle with a Capping of Stout Square Timber, fastened to proper Cables, secured against Fire, by putting over it a foot of earth and mortar composition for its better security against the effects of the Enemy's shells ; also in forming a high Traverse mound of Earth and other local precautions against any attempts the enemy may form to bear upon it from their Batteries on the Isthmus.

To prepare the levels at and about the post of Middle Hill Guard, so as to suit and receive occasionally four pieces of Artillery.

To pull down the Guard Room at Bona Vista in order to establish upon that situation a Battery for three guns towards the Bay.

To fit up a Cave near the back of the Artillery magazine leading up to Willis's (commonly called Poca Rocca's Cave) for the reception and accommodation of the Governor and his family.

For the execution of which several works this shall be your sufficient warrant.

Given at Gibraltar the 26th of July, 1779,

G. A. ELLIOTT, *Govr.*

By order, etc.,

J.R., Secy.

(*To* Colonel GREEN, Chief Engineer).

Digitized by Google

(5).

Ordnance Artificers allotted Double Pay.

The Warranted Artificers belonging to the office of Ordnance in this Garrison having represented to Colonel Green, Chief Engineer, that it has been usual for Persons of their respective professions to receive double pay when employed during Sieges, particularly at the late Siege of Minorca, and this Fortress being actually invested: I do therefore empower him to give his orders to the Paymaster of His Majesty's Ordnance to issue to each of them 1 Dollar per Diem from this date.

Gibraltar, 1st August, 1779.

G. A. ELLIOTT, *Gov^r.*

Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(*Continued*).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

Sunday, April 9, 1809. "The army commenced their march this day."

Jones, under orders to join Major-General Murray's Brigade, left Lisbon on the 11th, expecting to find it at Torres Vedras:—"It was very dark and wet during the latter part of the ride, and upon my arrival here I was surprised to find no English troops; I got a billet upon a small house, and found the people very civil." Next morning, he set off for Mafra—hearing that English troops were there, and found his brigade:—"Spent the remainder of the day in viewing the Church, Library, Convent, etc." This wonderful structure—one of John V. extravagances—built to rival the Spanish Escurial, is still one of the chief sights of Portugal. It served a variety of useful purposes during the war.

Next morning, the German Brigade—to which he was attached—consisting of the 1st, 2nd, 5th, and 7th Battalions of the Line, marched to Torres Vedras, where he occupied his former billet. The advance was resumed next day, as far as Obidos, where the division remained seven days:—"The rainy weather still continued; Lt. Hamilton and myself amused ourselves sketching this place." Jones was now attached to Major-General Tilson's Brigade; and on April 28th, "The army marched from Caldas; employed sketching the ground till this day." Here follow detailed and lengthy descriptions of the ground traversed, and of the repairs effected to roads in certain parts, to facilitate the passage of artillery, but as these details are of no interest to the general reader they need not be introduced. The magnificent convent of Alcobaca—of whose kitchen and commissariat arrangements Beckford gives such a delectable account—was reached the same night; and here ample accommodation would be found for troops and officers; we know, moreover, from the diary of many a British officer, that a generous hospitality was extended to them by the monks. Jones' diary contains the brief entry, "Dined at the Convent, in which I also slept; saw the library, Chapel, etc."

The march was resumed next morning, the division, about mid-day passing through the village of Aljubarrota, close to which was fought and won one of the most epoch-marking battles in Portuguese history.

Digitized by Google

Here, in 1385 the Castilian Army which had invaded Portugal was defeated with great slaughter. Amongst the spoils of victory was the King of Castile's tent, his "travelling Chapel" with all its priceless contents, and an immense bronze cauldron in which the food of the Spanish soldiers had been prepared. The latter—having escaped the devasting effects of Massena's invasion, is still one of the treasured mementos of Alcobaca. Little did the British soldiers who marched through Aljubarrota, on this occasion,—unless, indeed, they were better posted up in Portuguese history than is usually the case—realize that they were treading on classic ground, hallowed by the shedding of British blood in the cause of Portuguese independence, some four hundred years earlier. It was a singular coincidence that, at the crisis referred to, the King of Portugal,—aware how little chance his country, unaided, would have in the struggle with Castile,—had sent post-haste to England for assistance, whence arrived 500 of the famous English archers in time to share in the glorious victory of Aljubarrota. "The English archers," it is recorded, "did yeoman service, and repeated the glories of Crecy and Poitiers." It was to commemorate that great and glorious victory—in which British soldiers played so brilliant a part—that King John I. built the magnificent Convent of Batalha—the "Battle Abbey" of Portugal. And it was in that noble memorial that the Brigade to which Rice Jones was attached passed the night of April 23rd, 1809, he being billeted "upon a small house facing one of the doors of the church, where the people were extremely civil." The glory of Batalha was its Church; the Refectory and general style of living being on a much humbler scale than at Alcobaca.

The brigade advanced next day to Leyria, where Jones "got an indifferent billet in a house occupied by Staff Surgeons."

Next day, April 25th, 1809, was destined to be ever memorable in the annals of the Peninsular Army, "Sir A. Wellesley is arrived at Lisbon; Sir J. T. Cradock left this place and the command of the army this morning. Lt.-Col. Fletcher set off for Lisbon in consequence of all heads of Depts. being ordered to meet Sir A. Wellesley there." From this moment a new spirit was instilled into the allied troops; no further disaster befell them; strength, discipline, organization, mutual trust, and confidence in their leader increased from day to day, until, after many vicissitudes, but never defeat, four years later, in the glorious campaign of 1813, they drove the last of the invaders from the Peninsula, and on that ever-memorable 10th November, 1813, "the summit of the great Atchubia Mountain just lighted by the rising sun," to quote the inspiring words of the great historian, "fifty thousand men, rushing down its enormous slopes with ringing shouts, seemed to chase the receding shadows into the deep valley. The plains of France, so long overlooked from the towering crags of the Pyrenees, were to be the prize of battle, and

Digitized by Google

the half-famished soldiers in their fury broke through the iron barrier erected by Soult as if it were but a screen of reeds." And the sequel ? Is it not known to every schoolboy ?

The brigade halted at Leyria five days ; here our author fell ill, and though unable to accompany the troops when the advance was resumed, managed to overtake them at Pombal, where, owing to its crowded state, he was unable to obtain a billet, and had to push on to a village near, where "we were quartered in a good house belonging to a lady who seemed rather afraid of us, and frugal." Next morning, though "extremely ill" he accompanied the brigade to Condexa where, through the good offices of some officers of the German Artillery, he got a house "which was a very good one and the people civil." Coimbra was entered next day, May 2nd, "The approach to it, as you descend the hill, along the road from Pombal, is the most beautiful I ever saw, the Rio Mondego being below, having a long stone bridge over it, and the town with its numerous fine Convents on the hills in front." Here Jones was unlucky in his quarters again, "Procured a billet a great way up the hill in a poor house ; slept there, but found myself extremely ill in the morning."

MAFRA, *April* 12, 1809.

MY DEAR FATHER,

In my last I informed you of the arrival of Lt.-Col. Fletcher and the other officers. To my great annoyance since that time the army have moved forward, and, in the Brigading our officers, it was the intention to have left me in charge of the works at Lisbon, but fortunately Capt. Chapman heard of it and told Col. F. that it would be very cruel, (as he knew I had made up my mind to be attached to him) to leave me behind, and in consequence of his representations I have just arrived here to relieve Lt. Wedekind of the German Engineers who is to return to Lisbon. You cannot imagine how much I feel obliged to Capt. Chapman for his kindness. I really should have been in a state of despair had I been left. I believe I informed you of my making a Report upon the country I have been reconnoitring ; Capt. Chapman was good enough to assist me with his advice and opinion in drawing it up, and I understand the Commander in-Chief was pleased with it. I am, for the present, attached to Maj.-Gen. Murray's Brigade consisting of the German Legion which forms the Advanced Body of the left wing of the Army ; but I have applied to be appointed to the Brigade of cavalry, under Maj.-Gen. Cotton ; and this I have done for two reasons ; the first is that I intend to make use of Sir W. W. Wynn's name when I see the General, and the other is that I think I shall like the active service of a Dragoon Brigade. The Brigade I belong to marches to-morrow morning to Torres Vedras, and from thence to Obidos and Leyria. . . .

It is now generally understood that an engagement will certainly take place previous to our evacuating Portugal. Whatever may be the result I shall certainly endeavour, as well as the rest of the Army, to do my duty as a good soldier. My servant turns out very well indeed and is of very

Digitized by Google

great service to me. I have been obliged to get another horse for him and my baggage, for which I gave 90 dollars, but he is so poor I am dubious of his standing the campaign. All my baggage is once more afloat; we are ordered to embark it in the *Britannia*, No. 92, where it is now deposited, and I only have a blanket and portmanteau with me, besides the valise I carry behind at all times.

We are all quartered in an immense palace here, belonging to the Kings of Portugal; it is so large that although there are seven Regiments now in it, it appears capable of holding several more; it is also very grand and beautifully situated. . . .

I remain your most loving son,
RICE JONES.

LEYRIA, *April* 24, 1809.

MY DEAR FATHER,

I have just arrived here. I wrote to you on the 12th inst. from Mafra, since that we have marched to Obidos where we halted a week, and where I was removed from M.-Genl. Murray's Brigade to M.-Genl. Tilson's. I liked Gen. Murray very much the little time I was with him, and Genl. Tilson is very civil and kind to me; I accompany him the whole of the march; this is all I have to do with him as yet. We marched on the 22nd inst. from Obidos to Alcobaca, and proceeded to Batalha yesterday; we this day marched into Leyria which is at present the Head Qrs. of the army and is uncommonly full of troops; all the army being here except Genl. Murray's Division and . . . You have no idea of the difficulty there is to procure quarters and provisions at the different places we march through; very little or nothing is to be purchased after a Brigade has occupied a town a day or so, and we are obliged to depend upon the Commissariat issuing the rations we are allowed, but which it is often impossible to get, particularly forage for the horses; however my horses both get on extremely well, and if we halt here a day or two (which I rather think we shall) they will be quite fresh again.

My servant turns out very well; he is not yet quite up to foraging and buying provisions when they are scarce, but I daresay he will improve. . . . It certainly would have been as well if I had seen Genl. Beresford, but I thought it would appear forward or impudent to call often upon him; he is now a Field Marshal in the Portuguese Service, and a great number of officers have got rank along with him; however I am not ambitious of their honours, and would much rather serve with my own Brigade in Action than with them; indeed I should certainly have declined any of his appointments had they been offered to me. I understand that Sir A. Wellesley is arrived at Lisbon; I suppose that will cause a new arrangement of the army, if not new measures. We are quite ignorant of our intended operations, but imagine we are to advance towards the French. The following is the disposition of the army. (Full particulars are here given). . . .

We are now nearly 100 miles from Lisbon on the way to Oporto. This is a city and the largest place we have seen since Lisbon. . . .

Digitized by Google

I am particularly well in health, notwithstanding we march very early (in general about 4 o'clock) and it is seldom we can get breakfast—tea or milk, butter or cheese, it is useless to expect.

Your loving son,
RICE JONES.

ADDRESSED TO:—
CAPT. R. JONES,
ROYAL DENBIGH MILITIA,
STRATFORD COFFEE HOUSE, OXFORD STREET, LONDON.

For the stirring events of the next few days, we must turn to other sources for information. Our diarist is no Boswell; he indulges neither in gossip, nor in criticism of his superiors—as was so much the fashion in the Peninsular Army. Nor does he take one behind the scenes. Apart from this, he was laid up with illness during the stay of the army at Coimbra, and unable to take part in any functions, military or social. The only entries of interest are as follows:—"May 2, Sir A. Wellesley arrived here this morning: May 3, Marshal Beresford arrived; May 5, Maj.-Gen. Tilson's Brigade marched for Viseu, I was too ill to accompany them; Lt. Boothby took my place. Mr. Fitzpatrick pronounced my disorder as ague and ordered me Bark."

Sir Arthur Wellesley having been selected for the command of the army destined to drive the French out of North Portugal, the troops were ordered to assemble at Coimbra; the British regiments as they marched in, meeting with a most enthusiastic reception from the inhabitants; their advent "being announced," wrote an eyewitness, "by a ringing of bells which brought out crowds of people who lined the roads, bridge, and the streets of the city, receiving us with vivas and huzzas; the soldiers, as they passed, being covered with flowers, showered down from all the windows which were thronged with senhoras." At night, a grand illumination took place, which was repeated every night during the stay of the army. "And with every inducement to tempt us out; the streets being graced with a charming supply of Bonitas Senhoras, who professed 'gustar muitos os Officiales Ingleses bonitos,' (to be greatly pleased with the handsome English officers) we were, indeed, so cordially received and delightfully entertained, that it can hardly be called vanity to say we believed them in earnest."

Popular enthusiasm reached a climax on the 7th of May, when the army was reviewed by the Commander-in-Chief, on a sandy plain near the city; and an eyewitness wrote "a most imposing and magnificent spectacle it presented." The troops formed a line extending for over two miles; and when, after receiving the General, the regiments wheeled into column and marched past, "the excitement and enthusiasm of the spectators knew no bounds; the speedy and

Digitized by Google

final deliverance of their country from the French being looked forward to with the utmost confidence."

Lord Londonderry, an officer on the Headquarter Staff declared that, "to some of the troops which stood that day under arms, it is not going too far to affirm, that the whole world can produce none superior"; and he singled out for special commendation, the Brigade of Guards, the 29th and 83rd Regiments, and the four battalions of the King's German Legion, and he went on to state that the whole were in "the highest state of discipline and efficiency, and all appeared animated by one spirit—an ardent desire to meet the enemy."

A feature of this display, which attracted little attention at the time, and the enormous significance of which escaped the notice of nearly everyone present, was the appearance for the first time, in line with British troops, of the newly-raised Portuguese battalions, under British officers. Who, indeed, at that moment would have dared to foretell of these raw, half-disciplined, mean-looking recruits, the glorious part they were destined to play in the future liberation of the Peninsula? "It was impossible not to be forcibly struck with the superiority of the English over the Portuguese soldiers in external appearance," wrote Lord Londonderry, in comparing the two; adding, however, that "the latter seemed to be inferior specimens of their nation, being diminutive and narrow-chested in the extreme; yet were they extremely steady under arms." In justice to the Portuguese soldiers who cut such a poor figure, I would recall a circumstance which was probably unknown to the distinguished critic, and is habitually ignored by British writers, namely, that the cream of the Portuguese Army had been skimmed off by Marshal Junot, after his seizure of the country, two years previously, and these men, in accordance with Napoleon's invariable custom, were sent off to fight his battles in other lands, some even surviving to oppose us at Waterloo. Several of the Portuguese officers, to the eternal disgrace of their cloth, enrolled themselves under the Republican banner of France, and subsequently accompanied Massena, in the capacity of advisers, during his invasion of their country in 1810–11.

During the stay of the army at Coimbra, provisions were abundant, and, contrary to expectation, "the inhabitants supplied every article at a moderate price." Would that this noble example had been copied on certain notable occasions, in modern times! The enormous expense of supporting the army may be gathered from the statement, on reliable authority, that the British troops, alone, circulated in Coimbra a sum of not less than £10,000 a day; while the money spent by the entire army exceeded £100,000 per week; practically the whole of which was defrayed out of the British Exchequer.

The day after the troops had been reviewed by their new commander, was commenced the advance which reached its climax at

Digitized by Google

Oporto five days later, in that brilliant feat of arms commemorated in the title of the Duke of Wellington's eldest son—Lord Douro, followed by the expulsion of the French from North Portugal. The exultation with which news of the victory was received at Coimbra may readily be conceived. But had any one of the inhabitants of that proud and ancient seat of learning, whose towers were haunted by a thousand memories, at this moment of delirious rejoicing, been vouchsafed a peep into futurity, and venture to disclose his vision, like a modern Jeremiah, he would have been relegated forthwith to the Mondego, or an asylum.

Poor Jones was not fit to move before the 9th, when he rejoined his brigade, but "was unable to make any observations on this part of the country in consequence of illness." He was, however, sufficiently recovered to be able to be in the saddle at 2 o'clock next morning, and to accompany his Chief, Lieut.-Colonel Fletcher, on a long day's work, in course of which, news reached them that the army was in contact with the enemy; and towards evening, they passed over the ground from which the French had just been dislodged; and later, caught sight of the enemy retiring along the road to Oporto. The troops were halted; Colonel Fletcher and his party returning to Bemposta, near Pinheiro, where Headquarters were for the night. "I find myself nearly recovered now" is the final entry for the day. No tonic so good as a brush with the enemy!

An English traveller passing over the same ground, a few years later, tells us how he was shown "with pride the bed-room in which Wellington slept," in the Quinta of Meelhadas, on the night in question, and the very "log of wood in the courtyard upon which our hero, who had reached the Quinta before preparations could be completed for his reception, was found asleep, wrapped in his military cloak."

May 11th. "Rose early and rode with Lt.-Col. Fletcher to Oliviera where we waited until Sir A. Wellesley's arrival; we then accompanied him with the advance until about ½ mile from Grijo, when we perceived a body of the enemy's cavalry on a hill close to the road at a little distance from us. Our cavalry formed ready to charge, and our light troops commenced firing with those of the enemy that were in a wood which concealed the village and the French line. General Stewart's Brigade advanced also, and upon bringing up a gun the French cavalry retired immediately. The 16th Portuguese Regiment then turned their right flank, whilst M.-Genl. Murray's Brigade attacked their left and obliged them to retreat with precipitation. As soon as they had descended a hill on which they had encamped our cavalry charged them to Carvalhos, whilst our artillery played upon them from the hill. I was with Sir Arthur's suite this day." Headquarters were at the Convent of Grijal this night.

553448

Digitized by Google

May 12th. "Rode this morning early to Carvalhos where we heard the enemy had retired across the Douro during the night, and had blown up the bridge of boats across the river at Villa Nova. I was then ordered with Capt. Burgoyne, R.E., and a squadron of the 14th Light Dragoons, and the 2nd Battalion of the King's German Legion to the village of Vintos, in order to collect boats for the passage of the troops across the river. I proceeded with Capt. B. to the ferry above the village, where we found it was easy to procure boats. Capt. B. therefore directed me to rejoin the army and report to Col. Fletcher. I took the road to Villa Nova, and upon arriving at the Convent in that place, found Col. Fletcher with Sir A. Wellesley in a redoubt which had been evacuated by the enemy. I reported the state of affairs at Vintos and remained with them for some time, during which I observed the French retiring from Oporto, but their guards and sentries very quiet at their posts. A few boats then crossed the Douro to us, and General Hill's Brigade began to go over in them; as soon as they landed they marched up a steep hill and took possession of a large unfinished building. The French perceiving this marched down towards them in column, their light troops being posted behind the walls and in the gardens all round; the former were soon checked by the fire of some guns we had brought to the spot where Sir A. and we remained; while the latter were at length and with some difficulty dislodged. M.-Genl. Murray having now arrived with his brigade from Vintos, and Major-Gen. Sherbrooke with the Guards, and B.-Genl. Stewart's Brigade having crossed the river below, the enemy retreated immediately, and our cavalry charging them brought in many prisoners and left a number on the field. I crossed the river with Genl. Stewart's Brigade." A bed was found that night at Genl. Howorth's quarters.

The only entry of interest, next day, is that Colonel Fletcher had nearly completed a new bridge across the river, by the evening, to replace the bridge of boats destroyed by the French; "it was very wet all day." Next day, May 14th, Jones was ordered by Sir A. Wellesley to join Major-General Hill's Brigade, which he accompanied to Braga. Continuing the advance on the 17th, orders were received to return to Braga, which was reached again the same evening. Here, it was "reported that the French had dispersed, and our army was returning." Our author took no further part in pursuing the French over the border,—in which famous retreat they shed nearly everything but the clothes they stood in.

During the late fighting, two Engineer officers had been captured by the enemy, "May 19th, Lt. W. Thomson who has escaped from the French during their retreat, arrived, and dined with me." And next day, "Col. Fletcher arrived here with Capt. Goldfinch who has been fortunate enough to make his escape from the French."

Digitized by Google

Next day, May 21st, Jones returned to Oporto; May 23rd, "Employed all this day drawing a plan of the ground where we passed the Douro on the 12th. Went to the Opera in the evening with Col. Fletcher. I was this day very ill; rather better at night."

OPORTO, *May 13th*, 1809.

MY DEAR FATHER,

I have only time to let you know that thro' divine Mercy I have escaped unhurt during all the late severe but glorious affairs we have had with the enemy. Soon after writing to you from Leyria, I was taken very ill with an ague which I suppose I had brought from the coast of Essex; and at Coimbra, where the army halted, I was so bad that when M.-Genl. Tilson's Brigade, to which I was attached, was ordered on a service by itself, I was unable to accompany it. However when the army moved I persevered in accompanying them and very providentially recovered the very first day's march, and am now as well as ever I was in my life. Sir A. Wellesley's Dispatches will inform you more of the affairs than I have time to do. On the 9th instant we marched from Coimbra; on the next morning we fell in with and drove in their advanced post about 9 miles, and took their position at Oliviera. I was a little in the rear during this business, but came up in time to see the enemy retire from ground they had occupied about 400 yards in front of us. On the 11th instant after marching some distance we found them posted very advantageously at Greija, but in a little time we turned both flanks, and they retreated precipitately. I was near Sir Arthur all the day, and it was certainly a very fine sight, but was far exceeded by the passage of the Douro yesterday, and the defeat of the French at this place, which was as gallant a thing as was ever done: I was with the artillery cannonading them from the other side of the river at the commencement, and afterwards crossed with the 29th Regt. and B.-Genl. Stewart in time to make them scamper off. I have great reason to be thankful for my preservation. . .

Poor Hamilton of our Corps was very badly wounded yesterday; I understand a musquet ball entered one of his thighs and lodged in the other; the ball is extracted; I am now endeavouring to find him, to render him what assistance I can. . . .

Your very loving son,
RICE JONES.

OPORTO, *May 22nd*, 1809.

MY DEAR FATHER,

You must allow me again to write you a very hurried epistle; in fact we seldom hear of an opportunity of writing to England until a short time before the letters are sent; however I always write a letter if possible. I have just been favoured with yours which I was very happy at receiving. I wrote to you from hence the day after we took this place; the next day the whole army marched, and after pursuing the enemy as far as the borders of Spain through a country that they had burnt and destroyed wherever they could, and where it was impossible to procure

Digitized by Google

any provisions or forage (the inhabitants having all quitted their houses, most of which the French burnt) we have given up the pursuit, and great part of the troops are returned here, whilst the rest are returning as fast as they can. I believe we begin to move back again towards Lisbon to-morrow, in consequence of a French force having marched for that place under Marshal Victor; and it is said that we shall probably enter Spain as soon as we have beaten his army.

We are rather disappointed at our not having taken Marshal Soult and the whole of his army, but however, his troops are in a very distressed and scattered state, and certainly had a complete run for the narrow escape they have had; they have gone into Galicia and the force they have got off with are by some people estimated at 8,000 men; they have blown up great quantities of their ammunition, left great part of their guns, and an immense number of horses all along the road, some killed and others wounded, etc.; they have also lost great part of their baggage, and even left some of their knapsacks and kits about the roads.

Ever since the passage of the Douro on the 12th instant (which was a most daring, and as it turned out, most glorious attempt, and which the French all own they had not the most distant idea we should try to do, as they had destroyed the bridge) I have been attached to M.-Genl. Hill's Brigade, instead of Lieut. Williams who was left here ill, but who is now well and has relieved me. We marched from here on the road to Ponte de Lima for two days, when we received an order to join the rest of the army on the road to Braga: this turning out of one road into the other, threw our brigade into the rear, but which turned out rather fortunate than otherwise, as we did not advance so far in the country the French have destroyed, and consequently did not suffer so much as the rest of the army. Genl. Hill is a very good kind of man. I lived at his table during the time we were on the march, when it was impossible to get anything to eat elsewhere, and slept in the same empty houses along with his staff. Genl. Tilson's Brigade was at Chaves the other day. I expect to join them as soon as we can ascertain the way they are going; in the meantime I am with Col. Fletcher at Hd. Qrs., detached about in all directions, whenever a Brigade wants an Engineer with them. The Colonel is a very good man; he was particularly kind and attentive to me during my late illness, as were all our officers; Capt. Burgoyne removed me into his own quarters at Coimbra, and rendered me every little assistance which a sick person required. I am now getting quite strong again, and feel as well as ever I was in my life, thank God;—notwithstanding we have had a great deal of rain all the time we were marching after the French, and in general were obliged to sleep in our wet cloaks, etc. It is now very fine weather again. I should like to know what the people in England think of our attack of this place, as well as our other operations; I assure you we think it altogether a very gallant affair. . . . Capt. Goldfinch and Lt. Thomson are here, they escaped from the French during the confusion of their precipitate retreat and are very well. . . .

Your loving son,
RICE JONES.

Digitized by Google

P.S.—I assure you my losing the adjutancy had not any tendency whatever to make me uncomfortable; I believe I resigned it with as good a grace as most people would have done. I am only anxious to continue with the troops that keep the field, as I am very much afraid of being left in some garrison town; I have hitherto escaped, but had some near chances for it. My sickness was so far fortunate as it prevented my being detached with Genl. Tilson's Brigade which has not been in action, and perhaps also from being sent back to Lisbon with Capt. Chapman from Coimbra; he made every effort to remain with the army but could not. I have now made up my mind to be perfectly satisfied with whatever occurs, or as the French prisoners say, with the *Fortune de la Guerre*. My best horse stands the campaign very well, the other's back is very sore, I fear I shall be obliged to get another here until he gets well, altho' I cannot afford it. I am quite delighted at having been in all our actions; I am now beginning to be used to the whizzing of the bullets about one, which at first was not very agreeable, altho' everyone of course took it quietly.

The following interesting sketch of Wellington, during the pursuit of Soult's Army, is supplied by a Portuguese gentleman :—"I was a boy then, living at Salamonde. I recollect seeing the first two soldiers of the British Army who entered the city. They were two dragoons with carbines in their hands, who rode up the street without uttering a word to any one, and then halted like two statues. Soon after, others followed; and I cannot express to you the joy of our hearts—the enthusiasm with which your countrymen were received. My father, who spoke English perfectly, had received notice that Sir Arthur Wellesley would take up his quarters in his house, and dinner was prepared accordingly. It was towards evening, and I was with my father, when an officer wrapped in a large cloak entered the saloon, and told him that he had come to remain there. "I regret," said my father, "that I cannot give you the best accommodation my house affords, as the General is coming here himself." "I am the General," said the officer; and for the first time I saw your great Duke. Throwing off his cloak, and an orderly bringing in a case of maps, he desired my father to accompany him into an inner room, and there, for two hours did they sit looking over them, while my father was describing the country. During all this time dinner was waiting; but not a particle of food would the General touch till he had formed his plans. The following morning the army again marched in pursuit of the French."

The extreme difficulty of supplying the troops with food during the pursuit may be gathered from Wellington's General Orders; thus, under date May 17th, 1809 :—"The troops will have observed the extreme difficulty of supplying them with bread in this part of the country. . . . Till the army be in a more plentiful country the allowance of bread is to be one pound, and one pound and a half of

Digitized by Google

meat each man. . . . When bread cannot be delivered to the troops, they must have two pounds of beef for their ration." Short commons, as is invariably the case, brought demoralization in its train, and drew from the Bishop of Braga, who seems to have assumed the *rôle*, for the nonce of Commissariat Officer—the following mild protest:—"I likewise avail myself of this opportunity to inform your Excellency that, notwithstanding my endeavours that supplies of provisions of all kinds should be brought forward at this place for the use of the army under your command, I have not succeeded until now to that extent that I promised to do, on account of the arbitrary manner in which the provisions are taken possession of at this place by the different soldiers of your Excellency's army, etc., etc."

Another difficulty Wellington had to contend with was the improvidence of his troops, who, when entrusted with three days' rations, in advance, would consume the whole at a sitting, "from want of attention to this, and care of their bread, the best operations are necessarily relinquished." With a view to the prevention of the practice, orders were issued for the men's bread to be inspected twice a day.

On the return of the army to Coimbra, the Commander of the Forces issued the following stinging rebuke. "Not only have outrages been committed by whole corps, but there is no description of property of which the unfortunate inhabitants of Portugal have not been plundered by the British soldiers, whom they have received into their houses; or by stragglers from the different regiments of the army." And after describing the disciplinary measures rendered necessary by these disgraceful proceedings, the Commander of the Forces goes on to state that, "The people of Portugal deserve well of the army: they have in every instance treated the soldiers well; and there never was an army so well supplied, or which had so little excuse for plunder."

The sequel to this disastrous retreat is thus described by Capt. Charles Boothby, who was made acquainted with the facts by an intelligent French officer:—Marshal Soult, after he had effected his retreat from Portugal, immediately repaired to the quarters of Marshal Ney, at Lugo, and was ushered in by the officer above-mentioned, who, from the ante-room could distinctly over-hear the altercation that ensued. Soult on entering the room where Ney was, went forward with open arms to embrace him.

"Stand back," said Ney, "I don't know you, where do you come from? You come flying, like a coward, from the enemies of the Emperor."

"Allons donc," returned Soult. "I come to save Lugo, which you were on the point of losing."

"I neither want assistance," said the other, "nor are you in a condition to give me any. I have been met by hundreds of your

Digitized by Google

straggling fugitives. They all had abandoned their arms, that they might fly the faster; but their packs, heavy with plunder, were religiously preserved! It is you, Monsieur le Maréchal, who have taught them to throw away their muskets in order that they might carry the more booty, when your orderly-book gave up such a town as Oporto to a three days' pillage. Is that the way, sir, you consult your master's interests? To give up the second city of the country, you take in his name, to the horrible excesses of your brutal soldiers! You are no longer a Marshal of France. I will no longer acknowledge you as a chief in authority under the Emperor."

Ney, at length, became so grossly abusive that Soult, unable any longer to command his temper, used some expressions which so infuriated Ney that suddenly drawing his sword, he said, "Villain, defend thyself"—a mandate which was instantly obeyed; and the furious combatants were only, at last separated by General Mathieu rushing into the room. Meanwhile the quarrel had extended to the troops commanded by the respective Marshals, who had commenced firing at each other; and it was only by the personal intervention of their chiefs that the affray was stopped.

Headquarters having quitted Oporto on May 24th, Jones was ordered to reconnoitre the river Tamega from Chaves to the Douro; "but was prevented by illness and the advice of Surgeon Fitzpatrick; I still continued very ill indeed." The arduous duties of a campaign must have been trying to a young man who had just risen from a sick bed; and when on top of all this we come across such an entry as "arrived in the dark, and very wet; slept in my wet cloak, having waited in vain for my servant, until late," it is no wonder he was knocked over again, so soon. His brother officers had all gone with the army. "I am now quite alone and very unwell; consequently have little to do or write." Two days later, "Rode to Mr. Fitzpatrick's; I am considerably better than yesterday; continue taking quantities of Bark." Many a man would have grumbled at the hard luck which kept him in the rear, in such stirring times; but he writes;—May 28th. "The end of this day has nearly completed my 21st year, and therefore I shall begin a new book, hoping that when I arrive at the end of another I may have as much reason for thankfulness to God for his Providence as I have at present."

(Signed) RICE JONES.

Convalescence went on steadily; he was soon able to walk about the city; bought Lalande's *Tables of Logarithms*, and obtained the loan, from a wounded brother officer of *Zimmerman on Solitude*.

May 31st. "Rode with General Howorth and Surgeon Fitzpatrick over the ground of the action on the 12th; then crossed the bridge to Villa Nova, and visited the spot from whence we cannonaded the enemy on that day. NOTE.—We had four guns on the old French

Digitized by Google

work and one more, to the left. This was a very fine day, and the views of the city and river were delightful."

The operations pertaining to the passage of the Douro have been so fully described in various histories, that it is needless to recapitulate them here. It may be of interest to state, however, that, with the exception of the ground immediately adjoining the famous Convent whence Sir Arthur directed the operations on that memorable occasion, which was a good deal cut up for purposes of defence during the subsequent Civil Wars,—the river banks and the unfinished building which our troops seized and held after crossing, are but little changed since the eventful day in question.

Sunday, the 4th of June, finds our author once more on the march, after the army. "I rode a pony I have bought from Burgoyne for 60 dollars, and my large horse carried my baggage; the other's back being sore. In the afternoon it rained very fast. I halted here (St. Joao de Madeira) and got a billet upon a good house near the Church where I was used very well." Here follow as usual detailed descriptions of the ground traversed, from day to day, June 6th, he reached Coimbra. "Quartered in a poor house in Rua do Corpo Santo, and found to my surprise that Sir A. Wellesley had proceeded towards Abrantes." Setting off, in pursuit of Headquarters, on the 8th, with a friend, they called at the Quinta da Bouca,—"where we were very hospitably received by the Fidalgo who resided there, and who directed us the nearest road to Venda das Figueras." They halted for the night at Almofalla, "where I was taken by the Capitao Mor into his own house and was very well treated."

(*To be continued*).

Digitized by Google

HISTORICAL DOCUMENTS OF MAJOR-GENERAL SIR J. T. JONES, BART., K.C.B., R.E.

(*Concluded*).

The following report on the Artillery preparations for the Siege of Badajos was written for Sir J. T. Jones by Sir A. Dickson, R.A.

Preparations for the Siege of Badajos in 1812.

1812.—*Jany.* 20.—Immediately after the Capture of Cuidad Rodrigo, Lord Wellington made a Confidential Communication to the Departments most immediately concerned, of his intention to attack Badajoz as early as it was possible to prepare for the same. His Lordships first idea was to move to Elvas the Battering train that had been employed against Cuidad Rodrigo, or at least a certain number of the Guns, and to compleat the equipment from a proportion of besieging ordnance then in the Tagus, but the depreciated State of the Gun Bullocks, from Scarcity of Forage and the Severity of the Season having been pointed out, which gave every reason to fear they would be unequal to make such a march as that by Villa Velha with 24 Pr. Guns, it was suggested to his Lordship to apply to Admiral Berkeley, the Commander-in-Chief on the Lisbon Station, to know if he could supply a proportion of 24 Pounders from the fleet, to form in Conjunction with the besieging ordnance in the Tagus a new battering train for the proposed Undertaking, and if the answer should prove favorable, that an adequate proportion of the Gun Carriages alone belonging to the Cuidad Rodrigo Battering train should be sent to Elvas, together with 16 Iron 24 Pr. Howitzers, and a certain quantity of Ammunition. These Suggestions having been approved of by his Lordship, he immediately wrote to the Admiral to request if possible to be supplied with twenty 24 Prs. from the naval Department, which with 16 Iron 24 Pounders on travelling Carriages laying in Transports in the Tagus, and the resources of Ordnance that might be derived from Elvas, it was thought would afford Sufficient means for the attack.

Admiral Berkeley in his reply informed Lord Wellington, that the *Elizabeth* had lately gone to England, which was the only Ship on the Lisbon Station that carried 24 Prs., but as he always understood that 18 Prs. were good battering Ordnance, if that nature would answer for the purpose required, he could supply 20 Guns with Carriages and Ammn. Compleat.

The Admirals answer was Communicated to Col. Fletcher and Major Dickson, who both agreed the Service could be undertaken with the above mentioned proportion of 18 Pounders, though they would have greatly preferred the whole train to be 24 Pounders.

Digitized by Google

Jany. 26.—In the Interval however whilst waiting for Admiral Berkeley's reply, Lord Wellington drew up the following Memorandum.

Memorandum for Mr. Bisset, M. Genl. Borthwick, and Major Dickson, Jany. 26th, 1812.

1st. As soon as the Gun Bullocks will have brought in the Ordnance to Almeida it is desirable that the Sixteen 24 Pr. Carronades (Howitzers) should be sent off to the Alemtejo by Eight Bullocks to each.

They might go by easy Stages; and the 150 Bullocks required to draw the Bridge, might accompany them in order to assist in their removal.

2nd. Twenty 24 Pr. Guns and their Carriages, and Six Spare Carriages with their necessary Small Stores should likewise be removed from Almeida to Barca d'Alva. They should there be embarked in boats and Sent down to Oporto, and thence by Sea to Setuval.

3rd. A letter has been written to Mr. Boyes, to request him to send to Oporto all the 24 Pr. Shot and Spherical Case Shot that is at Villa da Ponte; and all the Powder 900 Barrels that is at Pezo de Regoa to Oporto; to be there embarked, and sent to Setuval by Sea without loss of time.

4th. As soon as the timber will be brought to Almeida from Cuidad Rodrigo, and the Bridge will be brought on the transporting Carriages to the same place from the neighbourhood of Gallegos, the Bullocks should be turned to grass.

5th. 1,000 Barrels of the Gunpowder recently arrived from England at Lisbon to be ordered immediately to Setuval.

W.

Jany. 28th.—This day Lord Wellington gave out a further Memorandum as follows:—

Memorandum on the operations against Badajoz, for M.-Genl. Borthwick, Major Dickson, Colonel Fletcher, and the Commy. General, Jany. 28th, 1812.

Major Dickson will proceed to Setuval in order to arrange the removal of the Ordnance and Stores from Setuval to Elvas; passing by Elvas.

5th Feby.—He will require to go to Elvas 7 days.

7th Feby.—To go to Evora 2 days.

8th Feby.—To Alcaçer do Sal 1 day.

10th Feby.—To Setuval 2 days, in all 12 days.

Mr. Bisset will be so kind as immediately to order an intelligent Commissary to Setuval with directions to make the preparations of Boats to convey the Heavy Ordnance and Stores from Setuval to Alcaçer do Sal.

The Same Commissary is likewise to Communicate with the Magistrates of Evora, and Alcaçer do Sal, and Setuval, to procure Bullocks and Carts to remove the Ordnance and Stores from Alcaçer do Sal to Elvas.

Supposing these arrangements to be ready by the time of Major

Digitized by Google

Dickson's arrival at Setural, and that he can immediately Commence
17th Feby. to remove the Ordnance and Stores from the transports.
21st Feby. It will then take Seven days to remove the Ordnance and
25th Feby.
8th March. Stores from the transports to the Boats, 4 days to arrive at Alcaçer do Sal, 4 days to prepare to move from Alcaçer do Sal, 12 days to March to Elvas. In all 38 days.

W.

Jany. 30th.—Lieut. Love marched from Almeida with 16 Iron 24 Pounder Howitzers, and a proportion of General and Laboratory Stores on his route for Elvas.

Feby.—In the beginning of Feby. Capt. Power marched from Almeida for the same destination, with 20 Travelling 24 Pr. Carriages, and 5 Travelling 18 Pr. Carriages, with a Considerable proportion of Stores. From the Heavy rains, and the difficulty of the route in the Winter season the Bullocks Suffered so much, that these Convoys were greatly retarded on the March, Lieut. Love not arriving at Elvas till Feby. 25th, and Capt. Power not till March the 3rd.

Jany. 30th.—Major Dickson Commenced his Journey this day for Elvas and Setuval.

Feby. 5th.—Major Dickson arrived at Elvas, and immediately proceeded to examine into the resources of that place, to ascertain what means it would afford for the intended Siege.

He found the following available Ordnance and Ammn. :—

English Iron 24 Pr. Geo. II.	4
Do. Do. 18 Pr. Do	2
24 Pr. Round Shot	10,000
18 Pr. Do. Do. ...	from 3,000 to 4,000
Barrels of Powder Chiefly English ...	3,500.

There were also 16 Portuguese Iron 24 Prs. and 5 Portuguese Iron 18 Prs., but it was thought better not to reckon on these, to avoid complication of Ammn. on account of the difference of Calibre.

Feby. 6th.—Major Dickson proceeded on his journey to Setuval, which place he reached on the 10th Feby., and on his arrival there he found the transports with 16 24 Pr. Guns and a full proportion of Stores and Ammn. at Anchor in the Bay, and the Same day Captain Gardiners Company of Artillery under Capt. Dansey arrive from Lisbon to be attached to the train.

Feb. 11th.—This Morning the Operation was Commenced of Shifting the Guns and Stores into boats, and sending them up to Alcaçer do Sal.

Major Dickson having ascertained that the 20 18 Pounders Admiral Berkeley had undertaken to supply, were Russian Guns equal to 20 Pounders of English Calibre, he proceeded to Lisbon, and made every effort to get this appropriation changed, but without Success, Admiral Berkeley not considering it advisable to take any part of the

Digitized by Google

Armament of the *Barfleur* 98 for this purpose, which was the only Ship in the Tagus having 18 Prs.

As the English Shot therefore would answer very badly for these Guns, recourse was had to the Stores of Portuguese 18 Pr. Shot at Lisbon, of which a very large quantity were sent to Alcaçer do Sal, but many thousand of these were obliged to be rejected being far too low.

Feby. 12.—A Detachment of 160 Portuguese Artillery men joined this day from Lisbon, under the Command of Captains Julio Cesar Pereira de Amaval, and Captain Thomas Cox.

14.—Capt. Dansey and Capt. Cox, with a Detachment of Artillery men, proceeded this day with the first Division of loaded boats for Alcaçer.

15.—Second Division of Boats proceeded up the river to Alcaçer.

14 of the Russian 18 Pr. Guns arrived.

16.—The whole of the 24 Pounder Guns, Stores, &c., have been forwarded to Alcaçer—as also all the Engineer Stores.

18.—14 18 Pr. Guns, with about 10,000 18 Pr. Shot sent off this day to Alcaçer.

Major Dickson removed this day to Alcaçer do Sal.

26.—From the 16th to the 26th Feby., the Artificers were hard at work in fitting Poles to the Gun Carriages, in repairing Block Carriages, fitting Sling Carts for Bullock Draft there being a deficiency of means for moving the Russian 18 Prs., and also in making Frames to keep the Shot from rolling off the Bullock Cars.

Within the same period, the remaining 6 18 Prs., and Considerable quantities of Shot and other Stores arrived from Lisbon by way of Setuval. In the mean time Convoys of Cars, Mules, and Asses, were dispatched for Elvas with Stores and Ammn. as fast as they were supplied by Mr. Laidley, the Commissary appointed to assist in the movement of the train.

This day Capt. Cox marched with a Division of 16 24 Pr. Guns for Elvas.

Feby. 27.—10 Russian 18 Prs. marched for Elvas under the charge of Capt. Julio Cesar.

Captain Barreiros arrived with a Portuguese Company from Elvas.

28.—The remaining 10 Russian 18 Prs. marched for Elvas under the charge of Capt. Barreiros, these Russian Guns have been received so nearly destitute of Side Arms and Small Stores, that Elvas and the equipment from the North must be depended on to furnish nearly every thing they want.

The Admiral is sending round 10 English 8 foot 18 Prs. which arrived at Lisbon in the *Nyaden.*

March 2.—Lord Wellington has ordered the 10 Nyaden 18 Prs. to be forwarded to Elvas. They were brought as far as Estremoz, and there halted, in consequence of the Siege Commencing.

6.—The operation of sending off Ammn. of all descriptions was Continued with the greatest Activity, the Asses proved very useful in

Digitized by Google

the Conveyance of shot, a great many were employed, and though the loads they took were very Small they made long Marches, and returned with great expedition, scarcely Sustaining any Casualty.

The operation being in a great degree Compleated at Alcaçer do Sal, Major Dickson set off this day for Elvas, leaving Capt. Daniel of the German Artillery in charge at Alcaçer, to send forward the remaining Shot and Powder required and also the Nyadens 18 Prs.

March 8th.—Major Dickson arrived at Elvas this day, where he found the train assembled and in good order as follows—the last division had just arrived :—

24 Prs. Iron	16
18 Prs. Do.	20
24 Pr. Howrs. Do.	16
Total ...	52

March 11th.—This day Lord Wellington arrived at Elvas from the North.

15th.—The preparations being Compleated, the large Boats and other Pontoons marched this day from Elvas to the Guadiana, about Four miles below the Tower to form Bridges, and General Le Marchants Cavalry with a Brigade of Infantry were passed over the river.

16th.—Marshal Beresford marched with the 3rd, 4th, and Light Divisions and invested Badajoz on the South Bank.

At this period the State of the Battering train for the Siege was as follows :—

Pieces of Ordnance as above	52
24 Pr. Round Shot from the North, from Alcaçer do Sal, and collected at Elvas, including 6,720 22 and 23 Prs.	22367
18 Pr. Round Shot from Alcaçer do Sal, and Collected at Elvas	17837
5½ Inch Common Shells	2562
5½ Do. Spherical Do.	2440
24 Pr. Grape	1680
24 Pr. Case	424
18 Pr. Grape	1000
18 Pr. Case	500
With an ample Supply of Powder. Additional Supplies of 24 Pr. and 18 Pr. Round Shot arrived from Alcaçer during the operation.	

The inequality of the 18 Pr. Shot was so great, that they were divided into three sizes, which were painted of different Colours to preserve regularity of practice.

March 17th.—Major Halcombe marched from Elvas for the Siege with 8 24 Prs., 10 18 Prs., and 8 24 Pr. Howrs.

Trenches were opened this night.

Digitized by Google

18*th*.—The remainder of the besieging Ordnance moved from Elvas under Capt. Rettberg, very heavy rain this day.

19*th*.—Head quarters moved to the Camp before Badajoz.

Half the Battering train was left at the Bridge, and the remainder moved up to the Siege, the Park was formed about 2,500 yards from the Place and out of sight from the Town.

As yet the Enemy have not fired any Shells.

Heavy rain in afternoon.

The Corps of Artillery for the Siege was as follows :—

	Rank and file.
British Artillery including 30 Artillery men of Kings German Legion	296
Detachments of the 2nd and 3rd Regiments of Portuguese Artillery	566
	862
British and Portuguese Artificers	25

Officers Names.

Major Dickson—Directing the operations of the Siege.

British Artillery.

Major May, Asst. Adjt.-Genl.
Major Halcombe.
Captain Gardiner.
Captain Power.
Capt. Latham, killed.
Captain Dansey.
Captain Dundas, wounded, lost an arm.
Lieut. Bourchier.
Lieut. Weston.
Lieut. Counel, killed.
Lieut. Grimes, dangerously wounded.
Lieut. Love, slightly wounded.
Assistant Surgeon Fitzpatrick—Acting Surgeon.
Assistant Surgeons Frazer and Kenney.

German Artillery.

Captain de Rettberg.
Captain Daniel.
Lieut. Luchow.
Lieut. Thiele, slightly wounded.
Lieut. de Goeben, severely wounded.

Portuguese Artillery.

Major Tulloh, wounded severely.
Captain Julio Cesar Pereira de Amaval, killed.
Captain Antonio Vellez Barreiros, killed.
Captain Cox.
Captain Mitchell.

Digitized by Google

Lieut. Diogo Francisco.
Lieut. Rodrigo Piuto Roby.
Lieut. —— Paez.
Lieut. Joaquim Felippe Lamprea.
Lieut. Joze Maria de Amaval.
Lieut. Roque Landeiro Pa. de Araujo, killed.
Lieut. Francisco Xavier Pa. da Rosa, lost an arm.
Lieut. —— Maximiano Vieira da Silva, killed.
Lieut. Joao Alberto Guerreiro.
Lieut. Carlos Anto. da Silveira, wounded.
Lieut. and Adjt. Theodoro Jose Duarte Quirido.
Lieut. and Adjt. Jose Joaquim Barreiros.
Assistant Surgeon Graça.

March 20th.—Much rain last night the Trenches were very full of water.

22nd.—The Enemy at work on an intrenchment under the Castle.

A Spaniard delivered up a dispatch from General Philippon to Marshal Soult in which he states that matters look serious.

23rd.—This night the Ordnance was taken into No. 1, and No. 2 Batteries, as follows :—

No. 1.—3 18 Pr. Guns, and 3 24 Pr. Howitzers.
No. 2.—4 24 Pr. Guns.

Three Artillery men were wounded in the operation.

3 24 Pr. Guns, and 1 18 Pr. Gun, brought from the Bridge this day.

The enemy kept up a heavy fire all this day.

March 24.—This night the following Batteries were Armed in readiness to open to-morrow viz. :—

No. 3.—4 18 Pr. Guns.
No. 4.—6 24 Pr. Guns and 1 24 Pr. Howr.
No. 5.—4 18 Pr. Guns.
No. 6.—3 24 Pr. Howitzers.

The Corps of besieging Artillery was formed into three daily reliefs, each relief consisting of proportions of British and Portuguese Artillery according to the strength of their respective Corps.

1st Relief Commanded by Major Halcombe,
2nd Do. Do. Capt. Gardiner,
3rd Do. Do. Capt. de Rettberg.

these being the three senior Captains with the train.

Lieut.-Colonel Framingham, Commanding the Royal Artillery, was present with the Head Quarters of the Corps, but he did not interfere with Major Dickson in the operations of the Siege.

Major Tulloh and Major May had a general Superintendance of the fire, to see the Batteries were properly directed.

Capt. Latham had the Superintendance of the Laboratory and of the Supply of Ammn. to the Batteries.

The Ammn. was conveyed in Bullock Carts from Elvas to the

Digitized by Google

Bridge, and from thence it was brought forward to the Park by the Small Arm Ammn. Mules of the Army.

March 25.—This morning Major Halcombes relief went on duty in the batteries, and at ½ past 10 oclock the fire opened as follows from 28 pieces.

	24 Pr. Guns.	18 Pr. Guns.	24 Pr. Howrs.	
No. 1 ...	—	3	3	To enfilade Commn. from Town to Picurina and against the defences.
No. 2 ...	4	—	—	against Fort Picurina.
No. 3 ...	—	4	—	against Lunette St. Roque.
No. 4 ...	6	—	1	on the production of the right face of Trinidad Bastion.
No. 5 ...	—	4	—	to enfilade right flank of Bastion of St. Pedro.
No. 6 ...	—	—	3	to enfilade right face of St. Roque.
Total ...	10	11	7	

The fire was kept up very briskly on both sides during the day, but Fort Picurina and Lunette St. Roque were soon silenced.

Captain Julio Cesar Pereira de Amaval, an experienced officer of the Portuguese Artillery, was killed, and Lieut. Grimes, Royl. Artillery, wounded.

The Howitzer in No. 4 was rendered Unserviceable by a shot from the Enemy soon after the batteries opened.

Fort Picurina was carried by Assault this night.

March 26th.—Capt. Gardiner with his relief on duty. Batteries 3, 4, 5, and 6, and the three Howitzers in No. 1, Continued their fire against the Enemies defences with the greatest activity during the whole of this day, the Enemy also kept up a very Vigorous fire.

A 24 Pounder Gun was disabled in No. 4 by the Enemies fire.

The Ricochet fire of the batteries was less effectual than might have been expected, but None of the distances were less than 600 yards, the lines to be enfiladed were short, and it required the greatest attention to keep the Artillery men, particularly the Portuguese, to the proper system of direction for this species of fire, they would not believe they were doing good in firing over the parapet, and they preferred striking the wall whenever they could do it unobserved, and this was done to such a degree, that the left face of the Bastion La Trinadad was very much injured at the Salient Angle.

March 27th.—Capt. Rettberg with his relief on duty. The fire from batteries 3, 4, 5, and 6 was kept up with vigour the whole day, and the Ricochet fire was now brought to more steadiness and effect.

The Enemy replied with equal activity, and one 18 Pr. Gun in No. 3 was rendered Unserviceable by their fire, and another in No. 5.

This day the remainder of the heavy Ordnance belonging to the Battering train was brought from the Bridge to the Park.

Digitized by Google

March 28.—The fire continued as before from batteries 3, 4, 5, and 6, but in the Course of the day two of the Howitzers having been dismounted in No. 6, and a number of Casualties having taken place in it from the plunging fire of the Castle, that Battery was dismantled and the Howitzers placed under cover.

Lieut. Counell of the Royal Artillery was killed this day, he had been very distinguished in the former Siege of Badajoz.

No other changes made this day or night with regard to the Artillery in the Batteries, except compleating and making good by exchanges all damaged Carriages, &c.

The Artificers hard at work in repairs.

N.B. The battering train never had more than 52 pieces as stated in page 9 of this detail.

March 29th.—The fire Continued as before from batteries 3, 4, and 5.

This night breaching battery No. 9 was armed with Eight 18 Pr. Guns, Three of which were those employed in No. 1, and Five were brought from the Park.

March 30th.—Batteries 3, 4, and 5 Continued their fire, and breaching Battery No. 9 of Eight 18 Prs. opened against the flank of the Bastion of Santa Maria, the practice was excellent, but the wall proved so hard and Solid, that apparently very little progress was made in breaching.

Soon after this breaching battery opened, the Magazine for its supply which was in the ditch of the right face of Picurina, was Unfortunately blown up by a Shell from the Enemy, by this four Artillery men were killed and Several wounded, and it also occasioned a good many Casualties otherwise. There were upwards of 300 18 Pr. Cartridges in the Magazine when the explosion took place, but no delay was occasioned in the fire of the Battery, as Cartridges were obtained from No. 3 till a Supply arrived from the Depot.

This night Batteries No. 7, 8, and 10 were armed as follows :—

No. 7 Breaching battery, 12 24 Pr. Guns against the right face of the Bastion of Trinidad, viz. :—

5 24 Prs. from No. 4.
1 24 Pr. formerly employed in No. 2.
6 24 Prs. from the Park.

12

No. 8 Breaching battery, of 3 24 Prs., and 3 18 Prs., against Flank of Santa Maria, viz. :—

3 24 Pr. Guns formerly in No. 2.
3 18 Pr. Do. from Park.

6

No. 10 Battery, 3 24 Pr. Howitzers to enfilade the ditch in front of the principal breach. These Howitzers were brought from No. 6.

Digitized by Google

March 31*st.*—The Distribution of the Battering train ordnance was now as follows :—

	24 Pr. Guns.	18 Pr. Guns.	24 Pr. Howrs.	
No. 1...	—	—	3	
3...	—	3	—	
5...	—	3	—	
7...	12	—	—	To breach Trinadad.
8...	3	3	—	Do. Flank Sa. Maria.
9...	—	8	—	Do. Do. Do.
10...	—	—	3	
In the Park...	—	1	9	
Unserviceable...	1	2	1	
	—	—	—	
	16	20	16	

6 Portuguese 24 Prs. were prepared at Elvas for Arming Battery No. 11, but these Guns never moved from that Fortress.

N.B. Col. Jones says No. 8 was directed against Trinidad, this is a mistake its fire was against flank of Sa. Maria.

Batteries 3, 5, and 9 Continued their fire, and 7, 8, and 10 opened for the Objects before mentioned.

At His particular request, Lieut.-Colonel Robe, lately returned from England, took the charge of Breaching Battery No. 7 at its opening.

The fire against the two breaches was kept up with the greatest Vigour during the day, and the practice was excellent, but as yet it had little effect on either point, and particularly Santa Maria, which was but little injured notwithstanding the increase of fire upon it.

The fire of the Enemy this day was particularly active.

Captain Antonio Villez Barreiros, Portuguese Arty., who distinguished himself in the former Siege by bravery and good conduct was mortally wounded by the Splinter of a Shell.

Lieut. Thiele of the German Artillery was slightly wounded.

During the night a fire of Grape Shot and Spherical was ordered to be kept up from No. 7, 8, 9 and 10, to prevent the Enemy from raising the Counterguard in the front of the right face of Trinidad.

April 1*st.*—It was discovered this morning, that the Enemy had succeeded in raising the Counterguard Several feet, in consequence of our batteries not having been sufficiently active during the night.

The following order was given to prevent a recurrence of this neglect :—

"*Reserve Orders, Camp before Badajoz,* 1*st April.*"

"It having been reported to the Commanding Officer by the Com-"manding Engineer, that the batteries with the exception of that "Commanded by Lieut. de Goeben, did not fire at the breach last "night according to the orders given, he is determined to report "every officer to Lord Wellington who shall neglect this duty."

The Batteries Continued their fire the Same as Yesterday, and by this Evening the revetment of the face of Trinidad was much ruined.

Digitized by Google

The flank of Santa Maria begins now to show some injury, but it is a very Solid Mass of Masonry, and is evidently Casemated.

Capt. Dundas lost an Arm and was dangerously wounded in the Side this day.

A fire of Grape was actively kept up this night, to hinder the rubbish being cleared away from the breaches, or any work being done in the ditch.

April 2nd.—A most active and well directed fire was kept up from the breaching Batteries the whole of this day.

The escarpe of the face of Trinidad is nearly down, but the clay stands very perpendicular being Supported by the Counterforts.

In the flank of Santa Maria, the piers of the Casemates are now opened to View, but they prove a Serious impediment to making a breach.

Lieut. Roque Landeiro Pa. de Araujo, Portuguese Arty., was mortally wounded by the Accidental explosion of Some Cartridges in Battery No. 7.

Lieut. Love of the Royal Artillery was slightly wounded.

This night Battery No. 11 was Armed as follows, to be employed against Lunette St. Roque, and afterwards to breach the Curtain of that front :—

	3	18 Prs. from No. 3.
	1	18 Pr. from Park.
	2	18 Prs. from No. 5.
Total ...	6	18 Prs.

3 24 pr. Howitzers were brought from the Park to No. 5 which now is Armed as follows :—

	1	18 Pr. Gun.
	3	24 Pr. Howitzers.

A fire of Grape Shot kept up on the batteries during the night.

April 3rd.—The fire of the breaching Batteries continued all this day with Unabated activity, and in the Evening both breaches wore a very promising appearance—a fire of Grape kept up during the night.

Battery No. 11 Commenced a fire against the Curtain between the Bastions Trinidad and St. Pedro, but after a Short time the fire was turned against the right shoulder of the Lunette.

Lieut. Maximiano Vieira da Silva of the Portuguese Artillery was killed, and Lieut. Francisco Xavier Pereira da Rosa lost an Arm, this Officer after Amputation could hardly be prevailed on not to return to his duty in the Batteries, and such was his Strength of Constitution, that he actually returned to Elvas on horseback the day after he was wounded. He was afterwards promoted for his good Conduct.

April 4th.—The fire of the breaching batteries Continued as before, and by the Evening both breaches appeared practicable.

Digitized by Google

An attempt was made to open the wall in the gorge of the Lunette of St. Roque by the fire of two 24 Pounders from No. 7, but the distance was too great, and the Wall too oblique to obtain the effect desired.

An 18 Pr. Gun in No. 11 rendered Unserviceable by a Shot from the Enemy.

Lieut. Carlos Anto. da Silveira, Portuguese Artillery, wounded.

During the night a fire of Grape kept up on the breaches.

April 5th.—The fire was continued on the breaches though they are now quite practicable and in a State to be Assaulted.

About 11 o'clock this morning three Guns of No. 8 were turned upon the Curtain, through the opening between the Trinidad bastion and the unfinished ravelin—the wall being visible to the bottom, the effect of these Guns was so great upon the Curtain, that Lord Wellington at noon when he reconnoitred and declared the breaches perfectly practicable, at the Same time determined to defer the assault another day, to afford time to open a third breach in the Curtain.

As many Guns therefore as would bear in No. 7, 8, and 9, were directed against the Curtain, and at night such other embrazures as could be turned to see it were altered.

The fire of the Enemy this day was very heavy.

A brisk fire of Grape Shot was kept up on all the breaches during the night.

Fourteen 24 Pr. Howrs. were taken to No. 12 this night.

April 6th.—This morning Eight 24 Pr. Guns, and Six 18 Pr. Guns of the breaching batteries, opened upon the new breach in the curtain, the wall of which was so bad that the escarpe was Speedily brought down, and by three oclock in the afternoon the breach was perfectly practicable. The remaining Guns of the breaching batteries were turned against the defences.

Lord Wellington in the afternoon having again examined the breaches, ordered the assault to take place this Evening.

The following was the disposition of Artillery for the Assault :—

Lieut. Bourchier with 20 Artillery men	...	to accompany column of 4th Divn. against the great breach.
Lieut. Weston with Lt. Joao Alberto Guerreiro { 20 Do.	...	to accompany Light Divn. in assault of flank of Santa Maria.
Lieut. de Goeben with 20 Do.	...	to Accompany 3rd Divn. in the Escalade of the Castle.
Lieut. Sinclair with 20 Do.	...	to accompany the escalade of the 5th Divn.

The above parties were under the command of Captain Latham, who attached himself to the 4th Divn. Column.

Digitized by Google

Captain Gardiners Company to follow the Column of the 3rd Divn. in the Escalade of the Castle, and to occupy the batteries bearing on Cristoval, &c.

Major Halcombe with a Sufficient number of Artillery men to man and prepare battery No. 12 of 14 24 Pr. Howitzers, in readiness to open its fire against the new battery under the Castle bearing on the breach, as soon as it is evident the enemy are aware of the attack, and to continue his fire till he sees the 3rd Divn. are in possession of the Castle.

Capt. de Rettberg with his relief to occupy the breaching and other batteries.

The Assault took place at the hour appointed, and though the Columns against the breaches were repulsed, the place was carried by the two escalades.

Lieut. Bourchier particularly distinguished himself in the Assault of the breach in the face of Trinidad, by leading the Column up the breach, when the Engineer appointed to that duty had fallen.

Capt. Latham was killed on the same breach, he had been very distinguished both in this and the former Siege of Badajoz, and he was an Officer of very Superior talent and ability.

Lieut. de Goeben was Severely wounded in planting the ladders for the Escalade of the Castle.

Major Tulloh was Severely wounded in the breaching batteries during the attack.

The Killed and Wounded of the British and Portuguese Artillery during the Siege were as follows :—

	Killed.			Wounded.		
	Officers.	N.C.O. and Gunners.	Total.	Officers.	N.C.O. and Gunners.	Total.
British Artillery	2	27	29	5	55	60
Portuguese Artillery ...	4	13	17	3	46	49
Total	6	40	46	8	101	109

The expenditure of Ammunition during the Siege was as follows :—

Powder	Whole Barrels of 98 lb. each ...	2'523
Shot...	24 Pr. Round	1'8832
	18 Pr. Do.	13'029
Shells	5½ Inch Common	507
	5½ Inch Spherical	1319
24 Pounder... ...	Grape	893
	Case	112
	3 Pr. Shot 1268 made into Grape...	158
18 Pounder... ...	Grape	328
	Case	168
	Total	35'346

Digitized by Google

Five pieces of Ordnance were unserviceable by the effect of the Enemies fire, viz. :—

24 Pr.	1
18 Pr.	3
24 Pr. Howr.	1
	5

The 24 Pounder Guns were much blown at the Vent, and all required Breeching.

The 18 Pr. Guns however were very little blown at the Vent, which may be attributed to the great windage of the larger proportion of the Shot, the effect of which was very observable, in want of force and precision.

Lord Wellington in his dispatch expresses himself as follows with regard to the services of the Artillery on this occasion :—

"Major Dickson conducted the details of the Artillery Service "during this Siege as well as upon former occasions under the general "Superintendance of Lieut.-Colonel Framingham, who, since the "absence of Major-Genl. Borthwick has Commanded the Artillery "with this Army. I cannot Sufficiently applaud the Officers and "Soldiers of the British and Portuguese Artillery during this Siege, "particularly Lieut.-Colonel Robe, who opened the breaching "batteries ; Majors May and Halcombe, Capt. Gardiner, and Lieut. "Bourchier of the Royal Artillery ; Capt. de Rettberg of the Kings "German Artillery, and Major Tulloh of the Portuguese."

"Adverting to the extent of the details of the Ordnance depart-"ment during the Siege, to the difficulty of the weather &c., with "which Major Dickson had to contend, I must mention him most "particularly to your Lordship."

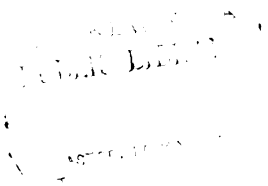
Great Praise also was due to Mr. Butcher, the Commissary of the train, for the activity, exactness, and good order he displayed during the operation.

Nor should Acting Surgeon Fitzpatrick be overlooked, who in the treatment of the numerous Severe Cases of Casualty, displayed the greatest talent and humanity.

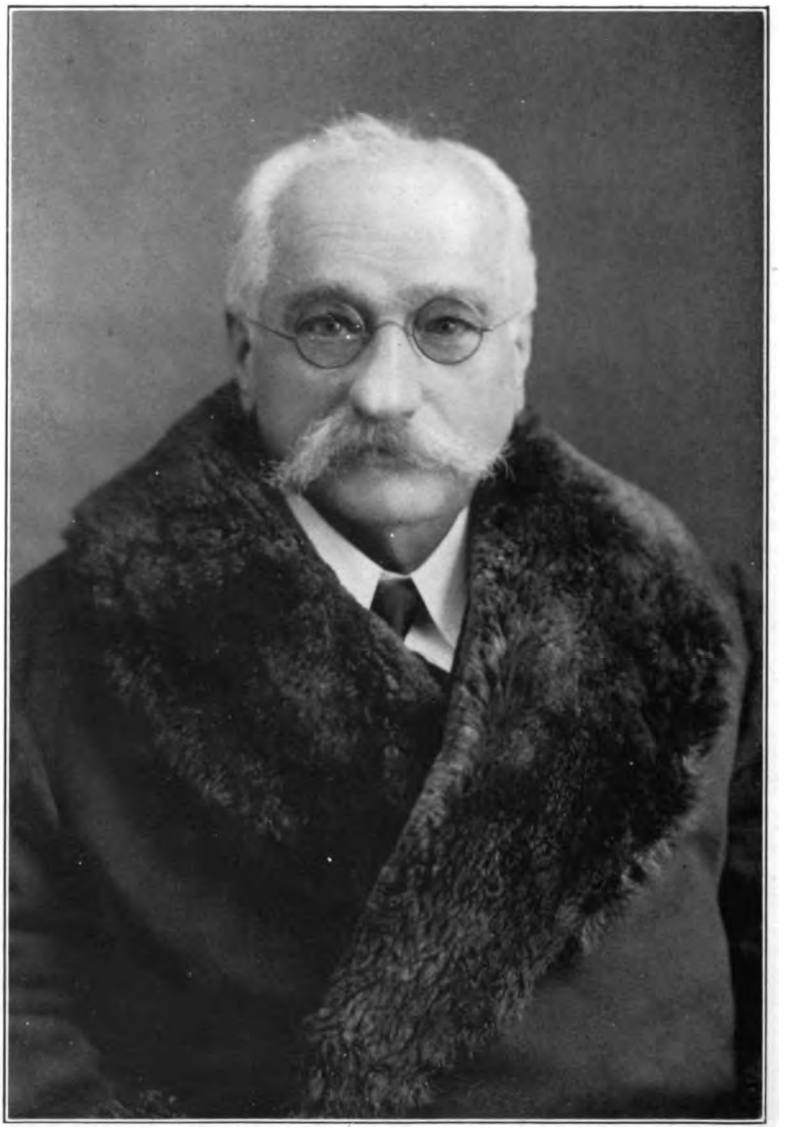
The greatest attention and Activity was displayed on the part of the Governor, and the Officers of the Arsenal at Elvas, in forwarding Stores during the Siege, but particularly Captain Joze Joachim Sabugal, who had the immediate responsibility of this duty ; Capt. Sabugal had been promoted for his good conduct in a Similar way during the former Siege.

A.D.

Digitized by Google



Digitized by Google



Major-General E. R. Festing, C.B., F.R.S.

Reproduced by kind permission from Photograph by Messrs. Maull & Fox, 187, Piccadilly, W.

Digitized by Google

MEMOIR.

MAJOR-GENERAL E. R. FESTING, C.B., F.R.S.

By Col. Sir Colin C. Scott-Moncrieff, K.C.S.I., K.C.M.G., LL.D., late R.E.

There are, I think, not more than nine or ten of our Corps now alive who were serving in the Army in 1857 and 1858 and who took part in the campaigns for the suppression of the great Indian Mutiny. One of these passed away on the 16th May.

Edward Robert Festing, well known as "Bob" Festing, was born on the 10th August, 1839. He was a pupil first of King Edward's School, Bruton, and then of the Ordnance School at Carshalton, and entered the R.M. Academy in 1854. These were stirring times when the long peace of Europe was rudely broken by the Russian War, and there was a great demand for officers in the Crimea. Young Festing then got his first Commission in 1855, before he was 16 years old, the youngest officer who ever entered our Corps.

He did not go to the Crimea, however, and I made his friendship a year later when we were at Chatham together. In May, 1857, the Mutiny broke out, and four companies of our Corps were despatched, two to Bengal and two to Bombay, the first Royal Engineers who had ever served in India. They went by what was then a new route, by sea to Alexandria, and by land across the Isthmus of Suez—for there was no Suez Canal for 12 years after that. At Suez the companies separated, two going round to Calcutta and two to Bombay. Among the latter was the 21st, under the command of Capt. Glastonbury Melville, and in this company young Festing was a subaltern.

The 21st Company was attached to a force commanded by Sir Hugh Rose (afterwards Lord Straithnairn), which had for its object to restore order and peace among the native states of Central India and Rajputana. The actors in these campaigns have never received their due. The agony of Cawnpore, the heroic endurance of Delhi and Lucknow, have overshadowed all else, and even historians tell the tale of the storming of Jhansi, or the long pursuit of Tantia Topee, as if they were chiefly concerned to be done with it as soon as possible. The recently published third volume of Mr. G. W. Forrest's *History of the Indian Mutiny* gives some idea of the

Digitized by Google

combination of headlong reckless courage and dogged endurance required from those who hunted Tantia Topee up and down the country until his betraval by his own kin. The heat was fearful; and on one occasion our troops were forced to give battle to the enemy at once, because so many were dropping down with sunstroke and other complaints that delay would have meant having none left to fight. Festing was unfailingly cheerful, even when confined to his tent with an attack of ophthalmia, or so covered with boils that he could not sit on horseback, and must march on foot, sufficient dooly-bearers not being procurable. His diary records "The General told me that he was very angry with me for coming out when I was laid up with boils, but that '*when I got to work, nothing could have been better.*'"

One of the finest incidents in the campaign of 1858 was what the official despatches term the "dashing and brilliant action" on the night of December 22nd, when a handful of our men surprised some 2,000 of the enemy encamped in a deep ravine among the jungles, attacked them, and put them to flight. Lieut. Festing was thanked in despatches for his share in this night's work, which is thus described in his diary:—"Heard that some of the enemy were encamped about 11 miles off in the jungle. Went after them at 6 p.m. Found the place by the aid of the guide at about 11—a wonderful ravine. We surprised them, but only killed one or two. Got lots of horses, but they took away their elephants. All over at 11.30."

It was after his return to England that the Department of Science and Art was formed, and Festing was employed in the formation of the South Kensington Museum. For the whole remaining years of his service he was connected with these great public buildings, and as I was employed during these same years in India and Egypt I cannot pretend to an intimate acquaintance with this part of his life, but I shall never forget the hearty welcome which I used to receive from him and Mrs. Festing when I returned on furlough. He had charge of the works of construction and maintenance of the buildings. He devoted much time to the arrangements for heating and ventilating and lighting the halls, which were a marked success. I believe that the installation of electric lighting in Government buildings began in South Kensington. All that Festing did was done thoroughly; and in his work he was assisted by the possession of an unusual gift of mental arithmetic which he retained throughout his life. All his tastes were scientific. He carried out many scientific investigations, and in 1886 had the honour of being elected a Fellow of the Royal Society.

Few were aware of how hard Festing's work was at one period of the Museum's history when, because of the risk from fire and the inadequate staff, he was occasionally obliged to stay on the premises day and night for weeks together, and could not even go out for a

Digitized by Google

walk. At one time, also, his work involved much travelling since he was obliged to inspect in person every school in the United Kingdom that applied for a building grant from the Science and Art Department.

One of his greatest achievements was the development of the Science Museum at S. Kensington. When first he took it in hand, it consisted of a conglomeration of wooden buildings on the western side of Exhibition Road. The fact that the roofs leaked in wet weather mattered comparatively little since the Science Collections then contained few items besides "Puffing Billy," the old steam engine, and almost the sole visitors were telegraph boys who took a short cut through the galleries, and small children who found free entrance here when it was pay day in the Art Collections.

Science was then the Cinderella at S. Kensington, to whom occasional half-pence were doled out by the Treasury with more than even the usual reluctance. But "when the Children of Israel made bricks without straw, they were learnin' the regular work of our Corps." Festing made the utmost of the very slender resources at his disposal, obtained loans or gifts of models from private sources, arranged and labelled his spoil with infinite pains; and when he was Director of the Science Museum, the collections were the admiration of scientific and practical workers of many nationalities.

His task was rendered easier by the fact that his subordinates worked for him gladly—despite his being no easy-going Director. "His eyes were everywhere," said one of them; "he never fidgetted you when you were doing your work properly, but he never passed over anything, and you could always speak to him as man to man and get justice from him." The letters received by his family in the last few weeks show how he was esteemed and regretted by all sorts and conditions of men; though many were written by civilians (some of whom professed a horror of "militarism") it is upon his soldierly qualities that they lay most stress. "It was very good for me," says one, "to know what an Engineer officer could be."

But busy as he was, he found time to follow other pursuits. No work for the welfare of boys ever appealed to him in vain. For 50 years he was on the Committee of the Boys' Home in Regent's Park Road—the first in London for destitute boys unconvicted of crime. For 21 years he was a Governor of Parmiter's Foundation in Bethnal Green. He was a School Manager, a friend to Boy Scouts, a patron of village Cricket Clubs. He was an ardent fisherman, and a good bridge player.

The reader of this article will readily believe that Festing was a man of many friends, a man much beloved. One of his colleagues writes, "His bright disposition and cheery manner made him always a welcome visitor, and did much to promote ready agreement on whatever business was on hand."

Digitized by Google

Another writes, "He brought when he came into the room I feel I may almost say a ray of sunlight."

Another distinguished colleague writes in *Nature*, "Festing was one who was universally beloved by his colleagues and by the subordinates who served under him. He was strict but absolutely just, and was no self-seeker. He was always ready to further the welfare of his men, or to assist in aiding the science teaching or research with which he daily came in contact at the Royal College of Science."

He leaves a widow and daughter and two sons. One of his sons, a Captain in our Corps, is now serving in India. The other is in the Ceylon Civil Service. His daughter is not unknown in literary circles.

The large number of mourners, old friends, and those who had served with him and under him in many capacities, who knelt by his coffin in the Brompton Church on the 21st May, bore witness to the width and depth of the affection which he inspired.

Digitized by Google

TRANSCRIPTS.

MY RECOLLECTION OF AN INDIAN BATTLEFIELD.

By Capt. M. Power.

Few Europeans now living have any recollection of the Battles of Moodhkee and Ferozeshahur, for it is more than 50 years since they were fought. I was at the time quite a youngster, just arrived in the country, and staying with a relative on the staff of the Governor-General Sir H. Hardinge. We left Calcutta in steamers and barges (called flats) under a salute of 19 guns, which were all the Governor-General was allowed in those days. Great crowds assembled on the river banks to see the "Moolkey Lat" (Lord of country, the Commander-in-Chief being called "Junghey Lat" or Lord of the Army) start on his long tour of two or three years in the Upper Provinces. The Governor-General's band on board one of the steamers struck up "Auld Lang Syne," and we steamed away past Barrackpore and Moorshidabad into the great river Ganges. Ignorant and inexperienced though I was, I could not help observing that we made all the speed we could, and that the fleet was kept going so long as there was light to see and avoid danger. Advantage was taken of moonlight nights to push on against the stiff current of the river, but the Government steamers of those days were such ancient affairs, and of such small power, that our progress was slow. I have often seen the whole flotilla take hours to get round a point, where the current happened to be stronger than usual—now gaining two feet, and then losing this small advantage. We got to Allahabad, passing Monghyr, Dinapore, Gazipore, Benares, Mirzapore and other towns on the river banks, in 18 days (the East India Railway now does the journey in 18 hours), or just three days under the ordinary time, and went into camp the same day. I went over the strong fortress here, which has the river Jumna on one side and the river Ganges on the other and was afterwards a tower of strength to us and a rallying point in the Mutiny of 1857, and thought it impregnable. Very little time was given us to settle down and arrange for camp life, as we began our march up-country two days after landing. The Governor-General was without his usual strong escort of infantry, cavalry and artillery; and we had only three companies of Native Infantry and two guns of European Horse Artillery with us. We pushed on, by forced marches, until we reached Bhurtpore, then, as now, the capital of an important Native State. We halted here for a few days in order, it was said, to rest the cattle and

Digitized by Google

camp-followers, but after events made me think that the real object of the halt was to give the Governor-General an opportunity of patting the Rajah on the back, and encouraging him to keep square during our coming struggle with our powerful and dangerous neighbours, the Sikhs. Like all native towns, Bhurtpore was a crowded, dirty place, with long narrow streets. It had, however, a good deal of interest for us, as the British found its fortress a hard nut to crack in the good old days gone by. It defied Lord Lake, and forced him to raise the siege and retire from before it; but Lord Combermere gallantly took it a few years afterwards. There was a curious tradition connected with its capture. It had been predicted and believed that Bhurtpore would never be taken by an enemy until a *koomeer* (alligator) appeared before its walls. When, therefore, they heard that another British Army under Lord Combermere (pronounced *koomeer* by the natives), was advancing against the fortress, the defenders lost heart and did not make such a good fight of it as they did before and probably would have again, had their enemy come with another name. We saw some of the alligator's teeth in the shape of marks of round shot in the great gates and in the walls.

The Rajah gave the Governor-General and his followers a splendid entertainment at his palace in the city, and after lunch there was an exhibition of wild animals—elephants, tigers, leopards, buffaloes, etc., etc., several of which were made to do battle with each other for the amusement of His Excellency. All I can recollect now was a fight between two elephants—one a tall, strong brute with long tusks, and the other just as strong, if not stronger, but shorter, with thick stout tusks. Both animals were led blindfolded into the walled arena, specially built for such purposes, having balconies around for the spectators. One entered from one end of the enclosure, and the other from the other end; the body of each being covered with a strong network of rope to enable the mahout, or driver on the back, to hold on and move about and encourage his beast during the fight. When all was ready and the ring cleared of the attendants, the covering was removed from the eyes of the elephants and they saw each other. Up went their trunks, and they hurled shrill and ear-piercing blasts of defiance at each other. The mahouts encouraged them by screaming and shouting, and they rushed at each other, the little fellow being most eager for the fight. I expected to hear a tremendous thud when they met, but there was not much of a shock. They seized each other by the trunk, and pushed with their heads, trying to prod with their tusks. The great object of each seemed to be to get on the side of the other so as to find a place to drive in the tusks, but both were wary, and, encouraged by the mahouts, who were shouting and gesticulating with mad excitement and looked like demons, kept face to face pushing and trying to prod with their tusks. After a time, the tall one seemed to get exhausted, and gave way a little. At last he lost ground, half turned, as if he had enough of it, and the little fellow took advantage of this and gave him a dig with his tusks near the shoulder, which nearly upset him. This ended the fight as the big chap groaned, turned tail and bolted towards his own gate of the enclosure which, seeing how the fight was going, the keepers had opened ready for him to get through. The

Digitized by Google

victor started in pursuit but had no chance against the long legs of his antagonist. who got through the gate a long way ahead, and it was closed and barred before the little fellow reached it. It was late when all this, and the fireworks which followed, were over, and it must have been 10 p.m. when we mounted our elephants to return to camp.

I have said that the streets of the town were narrow; they were barely wide enough to allow an elephant to pass, but would not admit the passage of two abreast. The night was pitch dark, but a torch-bearer trotted in front of each elephant. We had got about half-way through the town, when a stampede took place among the elephants, about twenty in number, carrying us. They trumpeted their fright and dashed off at top speed, shuffling along at a rate, that one, who has never seen a frightened elephant going, would not believe possible. The torch-men, knowing that frightened elephants are not particular where they tramp or rush, jumped aside and escaped into the houses, and away we were carried into black darkness expecting every moment to be pitched off by a stumble or tumble of the brutes below us. One elephant did actually jerk itself so suddenly from side to side in its fright as to send the occupants of the *cherjama* (a concern like the body of a jaunting car on which the riders sat on her back), on to the tops of the houses on each side of the street, but they luckily all escaped with a few bruises only. Some of the mahouts (they ride straddle on the necks of the elephants) tried to soothe and quiet them by soft words and by bending over and rubbing their foreheads soothingly, while others tried to stop the stampede by bullying the brutes and striking them with their *gugwaps*, (a short iron instrument like the end of a boat hook), but nothing had any effect until we got clear of the town, and then the beasts gradually cooled down and got quiet, except one which rushed into some jungle and damaged its *houdah* and the occupants, Major Somerset, Military Secretary to Sir Henry, and his wife rather seriously against the overhanging branch of a tree. I never could find out what caused the stampede; some said one thing, and others another, but I believe it was caused by a leopard. In former days, it was common for wealthy natives, in cities like Bhurtpore, Lucknow, etc., to keep hunting leopards, and I feel sure that our elephants must have scented or seen one of these while passing through the town, and hence their fright.

A rather funny occurrence took place during our visit. I think it is worth relating. The Governor-General, while in camp there, held a durbar for the reception of the Rajah. After the usual ceremonies and *attar* and *pan*, the Rajah said he had brought some of his best swordsmen and wrestlers to display their skill before His Lordship. A space in the centre of the great Durbar tent was at once cleared for the exhibition. The swordsmen commenced the performance, doing wonderful things with short and long swords. One of them brought in a sword about 8 feet or 9 feet long. The handle, a sort of hollow tube, was from 18 inches to 2 feet in length, and the arm went into it up to the elbow, and then the hand grasped a cross bar near the blade, and the holder was ready for action. The man who had it used the unwieldy weapon most dexterously, whirling it and flashing it about in all directions and cutting oranges off another man's hand and head with wonderful precision and ease. When they

Digitized by Google

finished, the wrestlers were introduced. They were fine, tall, powerful men, and their wrestling was magnificent. After looking at them for some time, the Governor-General turned to the Artillery Officer, who was in command of the guns, doing duty outside as part of the guard of honour, and asked whether he thought he had a man among his gunners who would have a chance with one of the wrestlers. The officer said, he thought he had, and left the tent. He returned after a few minutes, followed by a bulky red-headed horse artilleryman in full uniform boots, breeches, sword, brass helmet and all. The man came to attention and saluted. The Governor-General enquired if he could wrestle, and he said he could a little. His Lordship asked him if he thought he could throw one of the wrestlers; the brass helmet, who was an Irishman, replied: "I'll thry any way, ye'r Honour," and he stripped. He was a fine big fellow, no doubt of it, but all knew he would have no chance with a practised and trained native wrestler. One of the wrestlers, the biggest, stepped forward to meet Pat, and they faced each other. Paddy stood slightly bent, keenly watching his adversary. The native bent still lower, one hand resting lightly on his thigh just above the knee, and the other held out in front, ready to take a grip when opportunity offered. The native went around and around the gunner, now moving low and cat-like, and then bounding right and left—now raising himself almost upright, and again bending low as if ready for a spring, but never taking his eyes off Paddy. The latter turned as he turned, and kept a bold front to his enemy. Suddenly they were together, and poor Paddy was on his back, his red head coming down on the carpet with a thud. The wrestler strutted and swaggered about and looked contemptuously at Pat who had picked himself up, and was rubbing his red head and looking at the wrestler with no friendly eye. The Governor-General and all the Europeans laughed, but it was no laughing matter to Paddy. "I think, my man," said His Lordship, "you have had enough of it"; but Pat did not think so, as he replied with a look that meant mischief, "I'd like another thry, Sur." Sir Henry hesitated, but at last said: "Very well, try again." Once more the wrestler and Paddy fronted each other and went round and round as before. Paddy's right arm with a fist at the end of it like a sledge hammer was slightly drawn back, and the muscles of his great bare arm (the shirt sleeves were rolled up) stood out large and hard; his teeth were close set and his eyes had a wicked look in them, and he never for a moment took them off his antagonist. His legs were braced and well apart, one a little in advance of the other, and his feet were firmly planted one after the other as he turned, following every movement of the wrestler. Suddenly the latter bent as if to spring forward, and like a flash of lightning Paddy's big right arm shot out like a bolt from an engine, and the sound of the sharp harsh smash when flesh and bone meet flesh and bone followed, and the wrestler was on his back bleeding badly from nose and mouth, with cut lips and flattened nose and several teeth lying on the carpet. "Take that, ye thafe," said Paddy, and, looking as if only still half satisfied, he began to dress. All jumped up from their seats, and the poor wrestler was picked up and taken outside. The Governor-General looked half angry, but a twinkle

Digitized by Google

in his eye showed that he was not altogether dissatisfied with Paddy's way of settling the question. He, however, went over to Paddy, who was quietly getting into his boots to get back to his gun, and said, "That was hardly fair, my man." "And do ye think, Sur," said Brass Helmet, "That I was going to let the Nagur throw me about for nothing?" Saying this, he put on his helmet, saluted, turned and left the tent. The Rajah went away shortly afterwards, not, apparently, overpleased at the way his favourite wrestler had been handled. When he had gone, and the guard of honour had been dismissed, Sir Henry gave way to the fun of the thing, had a good laugh, and ordered the gunners an extra ration of grog all round. It will be difficult to persuade people in these days, when the British soldier is comfortably and suitably clothed, that the head covering of the Horse Artillery under the blazing sun of India was—gunner and officer alike—a brass helmet like that of a London fireman with the addition of a horse-hair plume, red or black, according to the brigade the troop belonged to. The infantry wore a small forage cap in a white cap-case with neck flap.

We left Bhurtpore after a stay of three days, and again pushed on by forced marches until we reached Umballa, tired and worn-out, and the escort and camp-followers nearly on their last legs. Here we found assembled a small army of 3,000 or 4,000 of all arms, including the 3rd Dragoons, which did such splendid service in the fields that followed. We remained some days at Umballa, and there was a good deal of hurry-skurry—dragoons and staff officers riding, for dear life, here and there and everywhere. Fresh troops joined the camp every day. There was a review of all arms after a few days, and though the number was small, not probably more than 6,000 or 7,000 Europeans and Natives all told, they looked splendid, and His Excellency was much pleased with their appearance and fitness. I was too young and careless to trouble myself about the cause of all this, and I had not the remotest idea of what it portended. It is true, I heard that the Sikhs were disturbed, but life in camp, with its marching, shooting and riding, to a raw boy just from home, had so many pleasures and was so delightful that I did not bother about anything else or look at the serious side of things.

We were joined by Sir Hugh Gough, the Commander-in-Chief, and by Major Broadfoot, the Political Agent on the frontier, and a general move was made towards Ferozepore. What with the Governor-General, the Commander-in-Chief, the troops and followers, there could not have been less than 20,000 people in camp, and we were joined here and there on the way by more troops who came across country by forced and trying marches to swell our numbers. The marches were long and distressing. The road, along which we moved, was a narrow unmetalled country road and altogether insufficient for the passage of such a host. All the cavalry, and most of the infantry, had to take to the fields and march on our right and left, leaving the road to the guns, carts, baggage animals, etc.

It was the month of December and the dust was something awful; and to add to our troubles, a drink of water became a luxury not easy to be got, as we crossed no rivers or streams, the country being flat, dry and sandy; and such wells as we met were instantly surrounded by hundreds of stragglers and native followers all dying of thirst who drew up the

Digitized by Google

water in brass *lotahs* attached to strings. A man was pulled up nearly as often as a *lotah*, as the pushing and fighting around the wells were so great and fierce, that every now and then two or three of the foremost would fall in; but there was little danger, as the wells were not more than from 12′ to 20′ deep, and the unfortunates got what they most wanted, viz., a good drink, and had then only to lay hold of half a dozen of the 20 or 30 strings around them, to be pulled up and placed on dry land again.

As we got nearer to the frontier, we found the villages more or less deserted, and it became difficult, and sometimes altogether impossible, to get anything to eat; and were it not for Jotee Persad, the famous Commissariat contractor, matters would have been very bad indeed. Every European, soldier or otherwise, in camp, received a loaf of bread and a pound of meat late in the evening, and as the fields all round were full of turnips, we had a sort of gypsy stew at about 10 o'clock at night and made a hearty meal, reserving half of our bread for next morning's breakfast. I recollect having to part with a portion of my half-loaf one day, but I did it willingly. It was in this way: I was going along on an elephant at a snail's pace among crowds of camels, carts, elephants, etc.: the heat was not much, though it was then about midday with a bright sun shining above, but the light sandy dust was something dreadful; it got into our eyes, down our necks, up our pants, half filled our mouths, and rested thickly on hair and eyebrows. I saw through the cloud of dust a European boy, about my own age, poorly clad and covered from head to foot with dust half inch thick, trudging along on his tired legs among the camp-followers. I made the elephant move to where he was, sit down and pick him up. He told me that his father was a private in one of the regiments with us; he had no mother, and as his father was too poor to support him, if left behind with the women of the regiment, he had to follow his father. He was very hungry and devoured the bread and raw turnip I gave him in no time. Years afterwards I met this boy, grown to be a clever, intelligent and rising man. He filled a high and important office under Government, but died a year or two ago in India which he had made his home. By this time, I got a general idea that the Sikhs were not behaving well, and that the Governor-General with the Commander-in-Chief and the army were going to bring them to reason. We had several ladies in camp, who had accompanied their husbands; but an order was issued directing all to return at once to Umballa. I saw them leaving: some bore up bravely against the great sorrow in their hearts at leaving husbands whom they were perhaps—nay more than likely—never to see again; whilst others broke down altogether. The grief of one sweet-faced kind-hearted woman, the wife of Capt. Beecher, Deputy Quartermaster-General, a fine fellow, a good soldier, and a kindly man who, I am glad to say, got through the campaign without a scratch, was uncontrollable, and I am not ashamed to say that I absolutely cried in sympathy as she passed me leaving camp on an elephant.

One morning, about the sixth after leaving Umballa, I was riding my pony and, as I was anxious to be out of the dust, I kept well ahead of nearly everything. A troop of cavalry was on the road in front, and I could see more cavalry on the right and left. It was about 1 or 2 o'clock, and I was

Digitized by Google

riding behind a party of mounted officers. Suddenly, and without any previous warning, two guns were fired from a village on high ground right in front of us, and I heard whizzing sounds passing to my right. The officers and cavalry pulled up, and all remained still for a few seconds; then a fine burly old man called out excitedly: "By God, those guns were shotted, and there are the Sikhs." This was quite enough for me. The officers dashed to the front, and I dashed to the rear. While getting to the rear, I noticed that the horse artillery, that magnificent arm of old John Company's army—which Prince Waldermar of Prussia, who was then in camp, afterwards pronounced to be the finest in the world—had left the road and were dashing at top speed, the guns bounding after them, over fields and ditches, to the front. The baggage carts, camels, elephants, etc., were halted, and the army got clear of the tangle, and formed up in front. But nothing further occurred, and after an hour or so, we were ordered to move forward. We passed the village whence the guns were fired, and found that it was named Moodhkee, and encamped just on the other side of it. There was not a man in the village, but there were a good many women and children who were brutally treated by our sepoys, when they looted the village next day.

The tents were up and things were settling down, and we were looking forward to getting something to eat. My tent was not far from the Governor-General's breakfast tent. I was lying on my bed munching a raw turnip, and wishing that I had some of the nice things which I knew were being discussed in the tent near me by Sir Henry and his staff—his son Charles, Private Secretary, a mild, good-natured man, and Ensign Arthur, the wild young Aide-de-Camp (afterwards Commander-in-Chief of Bombay), his nephew, Major Wood (Bob, Sir Henry called him), Capt. Munro, Capt. Hilliard, Major Somerset, Military Secretary (killed a few days after at Ferozeshahur) and Capt. Herries, who was killed that evening and buried by us next morning in his own tent—Sir Henry, and a few others being present. The Rev. Mr. Cowley read the funeral service. If I recollect rightly, Mr. Cowley was the only Protestant clergyman in camp. There was also with us a fine old Irish Roman Catholic priest belonging to the 50th Regiment, who lost his life three days after at Ferozeshahur while administering, midst shot and shell, carnage and death, the rites of his church to his dying countrymen. But to return to my turnip: before I got half through it, a sowar covered with dust dashed up at full speed, dismounted and rushed into the breakfast tent without any of the usual ceremony. He almost shouted at Sir Henry in his excitement, as I afterwards learnt—"Lord Sahib, you are eating when the Sikhs are at your door?" A grand commotion followed. Sir Henry, attended by his staff, rushed out swinging his one arm, called for his horse, and all mounted and galloped off in different directions. In five minutes bugles and trumpets were sounding all over the camp, and the wearied, footsore soldiers, who had done a long march and had not a bite that day, were everywhere hurrying from the tents they had just pitched, and taking their places in the ranks. In less than half an hour, the whole force, with the exception of a guard here and there, had left camp and marched, I was told, towards Ferozepore, and there was a hush

Digitized by Google

over everything about us. I had an idea that a battle was coming. I asked a friend in civil employment what was the meaning of all this, and was told laughingly that they had caught some Sikhs and were going to hang them. I was green and was trying to make myself believe that it was nothing more than this, when I heard the booming of guns not very far away, and I then knew that a battle had begun. I felt anxious and uneasy, and stood outside my tent listening to the guns. Several European soldiers who had broken down on the march and mounted the baggage carts, passed me hurrying on with blistered feet and limping gait, some without boots or muskets, looking neither to the right nor the left, but keeping their faces steadily towards the spot whence the sound of the battle came. Now and again one would stop a moment to ask me which way his regiment had gone, but I could give him no information, and he pressed on. On the other hand, I noticed that most of the rear guards and stragglers of our old Poorbia Army—the men who had been told in Government published orders over and over a hundred times and so taught to think that they, and they alone, had gained all our battles for us —and who in time actually came to believe, as proved by the Mutiny twelve years later, that they could beat us when they liked—did not in reality like getting to close quarters with our formidable enemy. They came into camp shouting "Bum! Bum! Bahadoor," and flourishing their muskets about frantically as if the prayer of many years to get at the Sikhs had been granted at last; but when they got through the camp and had a clear run before them to the battle, their ardour cooled; there was no more bum-buming, and they sneaked about the edge of the field until all was over. Some, however, (but they were a small minority), kept gallantly on with bayonets fixed and muskets at the trail. I saw two such plucky parties disappear at the double into the smoke before me. I saw all this and some of our troopers, Regular and Irregular, who had left the field, and were chasing and capturing loose horses as *loot*, when I plucked up courage a little later on and went towards the battlefield. I got as far as a big tree where a few wounded were being attended to by a gruff Scotch doctor. There was no ambulance in those days; simply a dooly and its bearers with the doctor's instruments and bandages. I may note here before I forget it that I was up in the village of Moodhkee, where the hospital had been established, next day, seeing if I could be of any help to the wounded. The doctors were busy cutting, carving and sewing; and each unfortunate was put in one of the many doolies scattered about when done with. I looked into one dooly and saw a poor body without arms or legs, wrapped in bloody bandages. As I looked, the lids lifted slowly, and the eyes looked at me full of dull sadness and pain. I dropped the covering of the dooly and turned away, as I could do nothing for the poor fellow. Near by, the doctors had General Sir Robert Sale, the hero of Jellalabad, on a native bed, and were cutting his leg off. They had thrown a handkerchief over his face as he lay patient and passive, but the first gash of the knife around the thigh was more than I could stand, and I felt sick as I ran away. The poor, brave, old General died the next day. The spot, where I was with the gruff doctor, was not altogether out of danger as cannon balls ricochetted past now and again. Had the ground

Digitized by Google

been hard instead of ploughed and soft, they would have gone into our camp. I stayed here for some time, giving what little help I could by carrying water to the poor fellows around me, and then returned to my tent. Towards dusk the sound of guns ceased and musketry only could be heard, but after awhile even this ended, and there was a great hum throughout the camp from the voices of the returned victors. I then heard that our small army, although taken by surprise, had beaten 30,000 Sikhs on a field of their own choosing, and taken 21 guns from them. The tired and hungry army that fought and won that battle after a long and weary march, consisted of five troops of horse artillery, one European (3rd Dragoons) regiment of cavalry, two or three regiments (including the Body Guards) of Native cavalry, four European regiments of infantry (9th, 31st, 50th and 80th) and some five regiments of Native infantry, or about 10,000 men all told; while the Sikhs had more than 40 guns and numbered over 30,000 men, the *élite* of the Khalsa Army. It was a battle to be proud of, but it was a touch-and-go all the same, because the Sikhs should and could have won, had they sent against our small and surprised army 50,000 instead of 30,000 men and more guns from the 80,000 or 90,000 men and any number of guns they had in their entrenched camp, only 18 miles away, at Ferozeshahur. I ate my stew in a hurry, put on my big coat, and went out to gather all the news I could about the battle.

I remember I got into the camp of the 31st, a fine regiment, nearly all Irish. The poor fellows had just had their dinner and grog after a long fatiguing march, a hard-fought battle, and a fast of twenty-four hours, and were excited over their victory. They were boisterously relating to, and reminding, each other of the occurrences of the fight. I heard how this "baste" of a "Sake" (Sikh), and that "baste" of a "Sake" in armour made for Paddy Doolan and Jim Flanigan, and how poor Paddy "was kilt, sthruk on the head wid a battle ax," Dan Casey bayoneting the "thafe that kilt him," and how Jim shot the other "clane through and through." But I noticed here and there one sitting apart smoking with quiet, sad face, thinking perhaps of some old comrade who had marched shoulder to shoulder with him for years and all that long day, now lying stark and cold in the dark jungle not a mile away. One soldier gave me a splendid bow and quiver, half full of steel-tipped arrows, taken from an "ould Sake" he had "skivered," and bade me remember it was a 31st man gave it to me. The brunt of the fight fell, of course, as it always did, does, and ever will, on the European portion of the force, and, handful though they were, well did they sustain the honour and glory of old England. Each troop, battery and regiment was as steady under the terrible artillery fire opened by the Sikhs at about 1,000 yards, as on parade, and every movement was executed with coolness and precision. The Governor-General said the day after that, much as he had heard of the Bengal Artillery, their behaviour in action surpassed his greatest expectations.

The Sikhs, beyond all question, fought bravely and stood well to their guns, and would have played long bowls with us as long as we liked as their guns were heavier than ours and their artillerymen were well up to their work. They did not care much for our European cavalry, though the 3rd Dragoons charged through and through them more than once;

Digitized by Google

they cared less for our native infantry, and certainly not at all for our native cavalry. But they could not stand the European infantry and the bayonet; and when we were at Lahore afterwards, I heard them strongly objecting to the cheers of the European regiments as they charged; they said, it was not fair, as it frightened them. The lusty British cheers and the glittering line of deadly bayonets in the hands of men whose set faces showed how well and fearlessly they would use them, were too much for the Sikhs, and they broke and fled. I heard that the Sikhs fought well and pluckily, and was told of many acts of obstinate bravery on their part, and they did not give in, even when lying wounded, but went on using their muskets, matchlocks and pistols, often shooting down the men who had just spared them. When they gave way, one dismounted chief in chain armour, disdaining to run, placed his back against a tree, and sword in hand kept a whole troop of the bodyguards at bay. He took a slice off an officer of the troop who tackled him, and was ultimately shot down by some passing infantry as he refused to surrender.

The British soldier of those days was a man fit to fight our battles, and no more like the boys of the present day than a beam is like a lath; the pluck remains, but the stuff and stamina are wanting. Both come of course with years, but when they come and the boys are seasoned soldiers, the short service system removes them to make way for more boys. Those were the days of long service in India, and the ranks were filled with fine bronzed powerful fellows fit for any work and any danger, and it seemed to me that two out of every three were Irish. When the 92nd Highlanders were quartered at Chinsurah, previous to moving upcountry in the Mutiny, I went up there one evening with some friends to see that fine corps. We waited in front of the barracks for some time thinking the regiment would come on parade, but were disappointed. Turning to leave, I met a splendid specimen of a Highlander with legs like those of a billiard table, dressed in white jacket, kilt, etc. I asked him if there would be any parade that evening, and he replied, "No, Sor." "Why," I said, "you are an Irishman," and he answered walking away, "Begorra, we'r all Irish."

But to return to my mutton. I got back to my tent at about 10 o'clock feeling elated and happy. I was tired and went to bed at once: I was, however, too excited to sleep for many hours afterwards.

I rose early next morning and after a cup of coffee and a bit of dry bread I got on my pony and went to look at the battlefield. I passed the big tree where I had been the previous evening, and came on a dead horse in artillery harness, but there was nothing unusual about the horse, no ghastly wound or anything that way, and I passed on. A hundred yards further and a little to the left, I saw something in a heap, with blue cloth here and there about it. I went up to the something and became sick and faint. The mass before me had been an European foot artilleryman: a cannon ball had struck the poor fellow below the chest and scattered everything right and left, leaving only the head and lower part of the body intact. It was an awful sight for a youngster. I turned away and went on, and strange to say in a short time, I got so used to what was about me, that I passed more than one equally distressing sight without experiencing much return of the

Digitized by Google

previous feeling. I came across many wounded European and Native soldiers who had been lying in the field all night. The latter and worse part of the fight took place in a sort of a jungle of low broad-leaved trees, Dhak I think they were called, into which the Sikhs retired with their guns after our first onset, and owing to the darkness that set in before the battle was over, many of our wounded were overlooked in this jungle and lay there all night. The European soldier bore this negligence and his sufferings calmly and patiently, and I found more than one chewing a bullet, but the wounded sepoy (then nearly always a Poorbia) was invariably whining or crying. I helped to get doolies for more than one poor fellow, European and Native, and saw them started for camp, and when no more doolies could be got, I gave my pony to a man of the 80th who had a bullet in his instep, sent to him apparently from one of the neighbouring trees. I cut his boot off with my penknife and found the bullet in it. A good deal of popping of muskets and pistols was going on, but not near me, and I thought they were only putting the poor wounded horses out of their agony, but I afterwards heard that some of this popping was done by wounded Sikhs who kept firing at our people until they turned and treated them like wounded horses. I was now on foot. Lying around me were lots of dead Sikhs, fine stalwart fellows, but mostly men of middle age, and many had long grey beards. They were dressed in blue breeches with a red stripe down the sides, and many had red jackets. One quite close to me was lying on his face with his pouch upwards, and a camp-follower had opened the pouch and pulled out the inside tin under which it was believed the Sikh infantry kept their gold-mohurs, but he was disappointed and hardly dropped the tin, when a bullet, no doubt fired at him by a wounded Sikh lying somewhere near, whizzed past close to my right temple and actually shook my hair.

This was worse than the two guns the day before, and I moved away from the dangerous spot in quick time, making homewards. I had not gone many hundred yards when I heard behind me a great noise and the galloping of horses, and on looking over my shoulder, I saw our people, black and white, mounted and on foot, following me as fast as their horses and legs could carry them. I felt that something must be wrong, and began to run too. A mounted artilleryman was the first to pass me, and in doing so called out, "Keep it up, youngster; the Sikhs are behind you." And I did keep it up, until I thought my heart would burst. I was passed by hundreds on horse and on foot. I looked back once and saw beyond the rushing crowd behind me, and in the jungle I had just left, bright spear-heads glittering in the morning sun; and as I was sure that these spears were held by mounted Sikhs, I kept it up over the ploughed fields until I could keep it up no longer, and dropped exhausted close to camp. I had on a pair of shoes when I began to run, but I do not know when or where I parted from them, and when I got cool, I found my woollen socks covered with burrs picked up in this desperate run, which gave me great agony then, but which I did not feel at all while "keeping it up." The alarm was sounded everywhere, and the troops got under arms. The cavalry and horse artillery were galloped to the front, but returned after an hour or so, and

Digitized by Google

the whole were dismissed to their tents. We were afterwards informed that our stampede was caused by a large body of Sikh cavalry sent out from their entrenched camp at Ferozeshahur to try and recover some of the 21 guns which we took the previous evening and left on the field to be brought in next morning; and I believe that they did succeed in getting back two. Some of our wounded were still lying in the jungle on the further side of the battlefield when this force surprised us, and I heard from more than one of them afterwards that the Sikhs, who brought oranges to give to their own wounded, threw some to our Europeans, but as often as not dropped a spear into the sepoys they came across. The Sikhs were, and are, a fine brave race, and I have liked them ever since.

I was present a few days afterwards at the touch-and-go battle of Ferozeshahur, which lasted, from beginning to end, nearly two days and two nights, and which the Sikhs would have won, had they been properly commanded and their chiefs been free from dissensions among themselves. Even as it was they must have won, had they held out a little longer, as our men had been fighting all the time without bite or sup, were starved, worn out and exhausted, and our ammunition all expended. I recollect seeing a well-dressed European woman—probably French, as the Sikhs had some Frenchmen in their service—lying dead within the entrenchment, who had apparently been accidentally killed by a stray bullet during the fight. I first thought she was a Cashmiri, who is often very fair-complexioned, but her white skin and clothes left no doubt as to her race.

A camp-follower tried to remove a Cashmere shawl from the body, but an Irish soldier of the 31st drove him off and nearly bayoneted him. He called to a few comrades and they buried the poor woman shawl and all.

I was also present as a spectator at the last great battle of the campaign—"Sobraon" or "Hurree ke-puttun" as the Sikhs called it, and at the unceremonious visit paid by Golab Singh, the Sikh Ruler of Cashmere, with little Duleep Sing, the Ruler of the Punjab, who was then a boy about 12 years old, to Sir Henry Hardinge, before we reached Lahore. They came on an elephant, escorted by four or five mounted men in chain armour and iron head pieces.

Digitized by Google

THE DEMOLITION OF WIRE ENTANGLEMENTS BY MEANS OF EXPLOSIVES.

Extracts from an article by N. Bobir in the January, 1912, number of *Injenerni Jurnal.*

THE translation and publication of the instructions which have been recently issued in France, led the author to study the best method of cutting a passage through a wire entanglement, and subsequently to carry out certain experiments.

The method of cutting a passage by sappers armed with wire-cutters can hardly be considered satisfactory. Only a fortunate accident would allow three or four men to creep by night up to the obstacle, and there unperceived to carry out their work in absolute silence. They must cut the wires not only at the nearer posts, but also at the farther ones, and besides this must try to remove them entirely, as their long curling ends will otherwise twist and entwine themselves together and round the remaining posts, and form a new and difficult obstacle, which being unforeseen may cause disorder in the attacking columns under the close fire of the enemy, and may seriously jeopardize the whole undertaking.

In the method of cutting passages by means of explosives adopted in Russia, the charges are made up into lengths of 8 to 10 ft. and are thrown over the top of the obstacle. If the latter is about 21 ft. in width two charges are required, and must be thrown with great accuracy, one further and one nearer, from a lying-down position. The success of the operation depends entirely upon the degree of accuracy with which the charges are thrown. It might be possible, though difficult, to push the nearer charge under the obstacle, but it might catch in the ground, and in any case it would reach only to a distance of 8 to 10 ft., and longer charges are unsatisfactory on account of their weight. In this case the passage cleared by the explosion does not exceed 10 ft. in width, and it is generally found that portions of the obstacle are left undemolished, owing to the more or less accidental position of the charges.

The method accepted by the French, and also by the author in the experiments which he here describes, is that of attaching the charge to a long wooden bar which can be divided into three or more sections. The sections can be carried separately to the scene of the demolition and there put together and launched under the obstacle.

The bars used in the experiments were cut out of 1-in. or 1½-in. plank, and were made 3 in. wide to fit the shape of the pyroxiline cartridges. For convenience of weight the sections were made 6 ft. in

Digitized by Google

length, except the head which was 6½ ft. The method of joining any two of the sections together is shown in *Figs.* 1 to 4. A thin wooden rod is fastened in a slot on the under side of the front end of one section, and its projecting end fits into a tubular cavity formed by a slot and iron plate in the rear end of the next section. The front end of the first section is pointed and fits into a recess in the rear end of the next section, this being done to ensure that the charges, which are bound along the upper side of both sections, may fit together with an even surface.

Figs. 5 to 7 show the head, which is intended to force its way under the entanglement and to protect the charge from damage during the operation.

The metal cap is made of galvanized iron sheeting, and covers on the upper side of the bar the front end of the charge, and on the sides a pair of wooden wheels, which must not exceed 6 in. in diameter, as otherwise they might prevent the charge from passing freely under the lowest wires of the entanglement.

The portion of the charge resting on each section is sewn up separately in canvas and lashed securely to the upper side. A fair proportion of fuzed primers is inserted in it. The charges average about 2½ lbs. of pyroxiline to the running foot.

The number of sections of the charge can be decided by the width of the obstacle. If the obstacle has an average width of 21 ft. the length of the charge should not be less than 18 ft., if of 28 ft. four sections will be required, making a total length of 24 to 25 ft. The explosion may be counted upon to clear a space 5 ft. wider than the length of the charge, but for greater security it is better that this figure should be reduced.

The charge must be made ready beforehand. It requires from three to four men, 16 to 17 ft. run of planking, 7 in. wide and not less than 1 in. thick, about 2½ square ft. of galvanized iron sheet, and two hours of time. The sections are dragged to the place where the charge is to be joined up, each in charge of one sapper, the men following one another at intervals of 5 to 10 paces. The firing should be confided to a non-commissioned officer, who should carry two port-fires, one spare.

The sections must be joined up at the place from which the charge is to be launched, and as each joint is carefully completed the bar is pushed forward under the entanglement.

The site of the demolition must be selected by means of careful reconnaissance beforehand. This is especially important where the entanglement is screened by a glacis, which however is very rarely the case. Here it is necessary to find a breach in the glacis made by a friendly shell, and both the breach and the direction of its approach must be carefully noted.

In the experiments carried out, the obstacle was made 21 ft. wide and was protected by a glacis in which a breach had been artificially made by the explosion of a mine. As a result of the explosion a clearing was made completely through the entanglement, with a width of 16 ft. on the near and far ends of the passage and 18 ft. in the middle of it.

Digitized by Google

Fig. 1. Front end of 2nd Section.

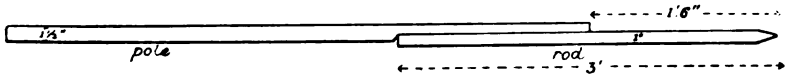


Fig. 2. Rear end of 1st Section.

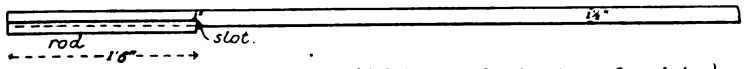


Fig 3 Method of joining the Sections (seen from below).

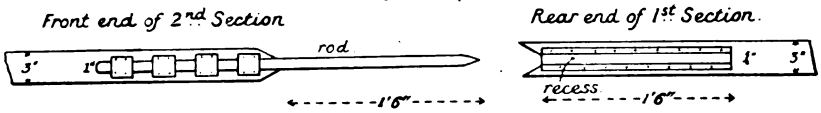


Fig. 4. Seen from above

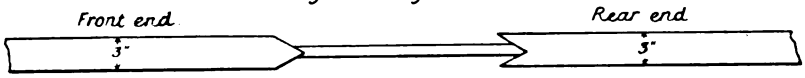


Fig 5 Front Section of Charge with fixed head.

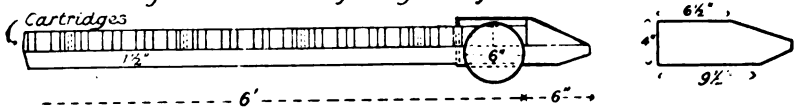


Fig. 6. Seen from above.

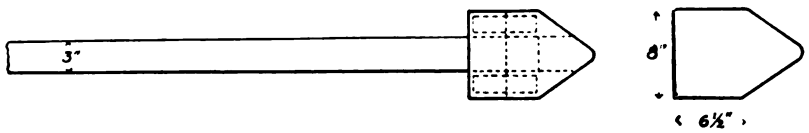
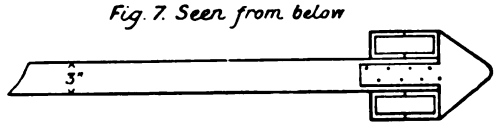
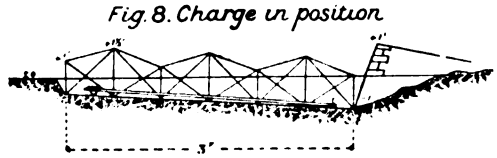


Fig. 7. Seen from below



Figures 1 to 7. Scale 1/10th

Fig. 8. Charge in position



Digitized by Google

The following special advantages are claimed for this method of cutting through obstacles :—

(1) The charge may be made to fit any width of obstacle ;
(2) The length of each section is optional and depends only on weight and portability ;
(3) The metal-capped head and wheels enable the charge to be pushed easily under the obstacle ;
(4) The charge can be brought up and exploded in five minutes, and this in absolute silence ;
(5) The explosion leaves a perfectly clear passage, of fully sufficient width.

It should be added that in order to bring up the charge and launch it skilfully, frequent practice, and practice only, is necessary. Actual demolitions should always be carried out by night, in the presence of infantry who are prepared to attack through the gap, and who will gain useful instruction by witnessing the demolition. Infantry should also be taught to carry out such demolitions themselves, as sappers may not always be available.

It would be worth while trying a similar experiment with the charge lashed on the under side of the bar, when the results would probably be better and the clearing wider. Also it could be tried upon various kinds of entanglements, with high posts or low ones, placed nearer or further apart from one another. As the expenditure of explosive is heavy, care should be taken to record and report the conditions and results in every case.

F. E. G. SKEY.

Digitized by Google

CORRESPONDENCE.

NOTE ON EXPERIMENTAL MODELS OF THE ARMSTRONG PROPELLER AS APPLIED TO SUBMARINES AND AEROPLANES.

DEAR SIR,

The following notes and drawings taken from the *English Mechanic* of August 25th, 1911, explain fully the nature of a propeller, as applied to submarines and aeroplanes, which I have invented and which I think would prove of interest to readers of the *R.E. Journal*, and briefly explain the construction and properties of this invention :—

"This propeller is of the nature of a feathering fan or paddle, and is adapted to work immersed in any single fluid, such as air or water, as well as in the ordinary way. This is effected by rotating the blades or fans so as to oppose their effective surface to the fluid operated on for only one-half or less of a rotation, the blades or fan being on edge through the major portion of the rotation, and so to give a thrust on the fluid in one constant direction.

With this is combined a means by which the position in which the changes of the paddle or fan blades from surface to on edge can be adjusted, from a line horizontal to one vertical, thus giving the propeller the means of raising or sinking the submarine, airship, etc., to which it is attached, irrespective of changes in ballasting.

In the drawing, *Figs.* 1 and 2 represent an edge and front elevation; 2 represents the fan blades, to which are attached the cams 4. These would be free to rotate but for the shape of the Geneva stop, cam 4, which bears on one of its faces on the disc 5. This disc 5 carries usually a pair of pins, 7, with recesses cut around for clearance (opposite, or at a lesser angle), which constitutes the means of rotating the Geneva stop and blade as it passes over these pins. Owing to the well-known properties of the Geneva stop action, this is accomplished without shock or vibration, even at considerable speeds.

Figs. 3 and 4 show anti-friction arrangements of this action. The disc 5 runs loose on the driving axle 6. It is shown fitted to a worm and screw adjustment, 9, 10, by which it can be rotated, and the turn-over pins 7, 7, made to dip up or down as required, with reference to the vessel to which it is attached.

Digitized by Google

Fig. 6 shows an adaptation to a wheel and a tyre. *Fig.* 5 shows how snugly a pair of propellers will fit to the under curve of a vessel. This particular pattern hardly needs any description; it can be modified by using a balance-gear drive, as in a tricycle, to drive the propellers with the discs 5 placed inwards, and regulated from inside the vessel; also with drum-brakes on the half-axles each side of the balance gear, as a means of steering by applying resistances to the brakes; it also forms a means of equalizing variable resistances, due to currents, side winds, etc. These wheels may be employed singly or in combinations. *Figs.* 7 and 8 show the propeller inclosed in a casing for use as a motor, pump, fan, exhauster, etc."

Nearly all existing submarines and aeroplanes depend upon inclined planes to convert a part of their forward motion into a rising or a falling one, and have no power to rise or fall except as a function of their proper motion, they are in fact but horizontal rudders and act in the same manner as the ordinary vertical rudder but in another plane, apart from the initial forward or backward motion they are unoperative.

My invention propels in any direction tangentially to the plane in which the propeller is being driven with the means of producing that tangential propulsion at pleasure at any position about the arc of the circle in which it operates, either vertically, horizontally or at any angle, apart from the motive power operating the propeller, there is hence no interference with or reversal of the motive power to propel up, down, forwards or backwards or any intermediate direction, this is an important point with internal combustion engines.

The submarines at present diving or rising being a diagonal or inclined motion, the turmoil created by the body of the submarine and the drag of the periscope betray the position of the vessel when in action.

With respect to my models as I am an old man and make up my models entirely with my own hands and appliances they are but small and roughly put together yet I have experimented with some dozens of arrangements and with respect to submarines can show that a rubber spring model which in my bath will

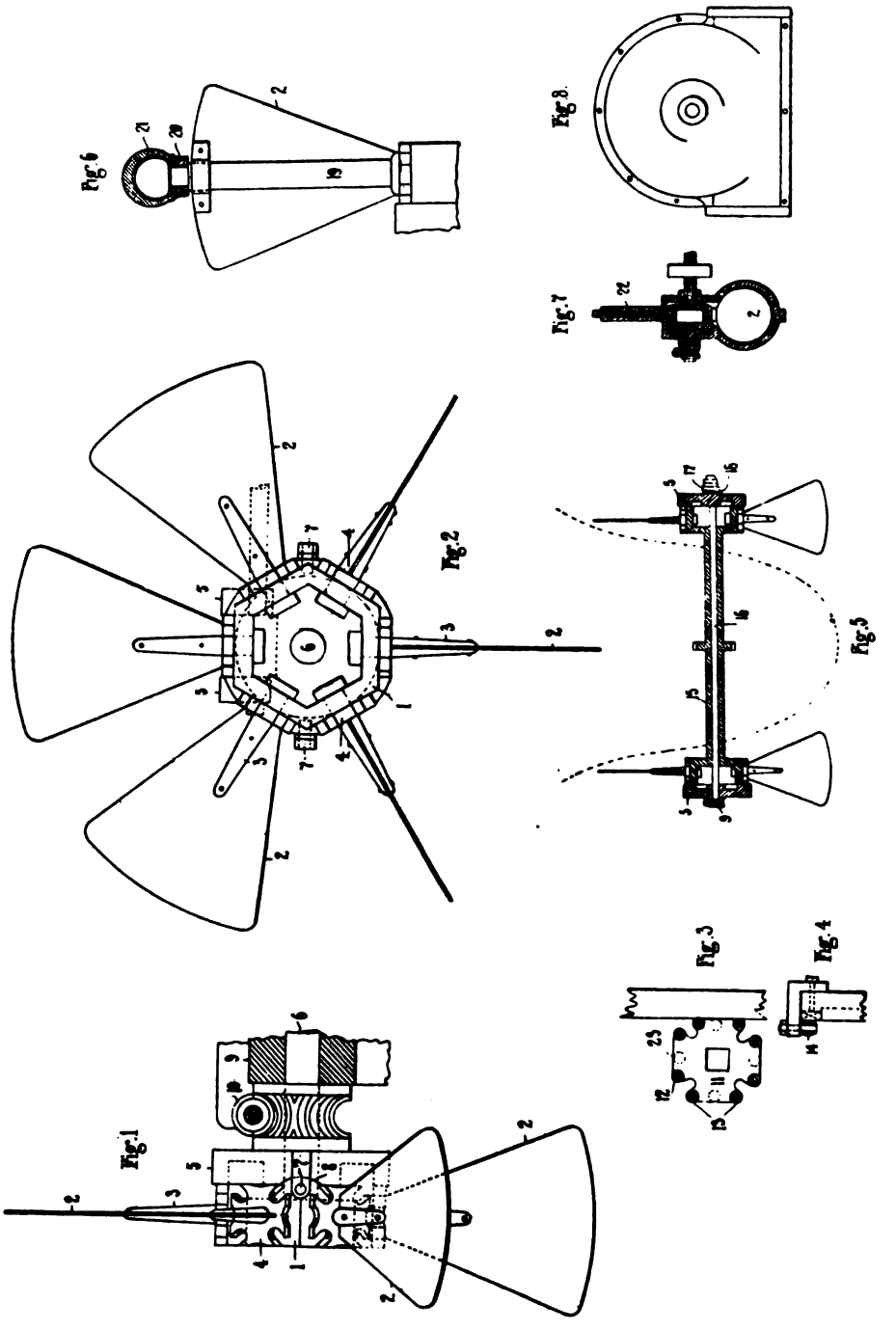
1. Propel itself forward "awash."

2. Propel itself downwards to the bottom on an even keel. Discharge a dummy torpedo.

3. Propel itself backwards "submerged."

4. Propel itself vertically up to the surface and is then in a position to repeat the cycle of operations. All this is effected by the propeller alone (without aid from any planes or fins) governed by the rotation of the disc with its engaging pins which determine the part of the arc of the vertical circle in which the turn-over of the vanes or paddles is to be made operative, it is actually an all-round vertical propelling gear. Horizontal steering may be by a rudder, or positively by the use of balance gear between pairs of propellers as noted towards the end of my descriptive note in the *E.M.*, this type of gearing might be easily controlled by a plumb or level to create the requisite resistances to

Digitized by Google



Digitized by Google

cause the propellers to maintain or correct any tendency to side or end deviation from a cross plane or line of direction.

With respect to models of aeroplanes, etc., my propellers are mostly fitted with tyres so as to drive the machine to which they belong along the surface until the velocity is sufficient for it to rise by the wing or kite surface supplemented by the upward beat of the propeller blades. As I am still experimenting with their applications and may have yet to secure protection for certain devices I may later on have more to say if this note creates any interest.

Yours faithfully,

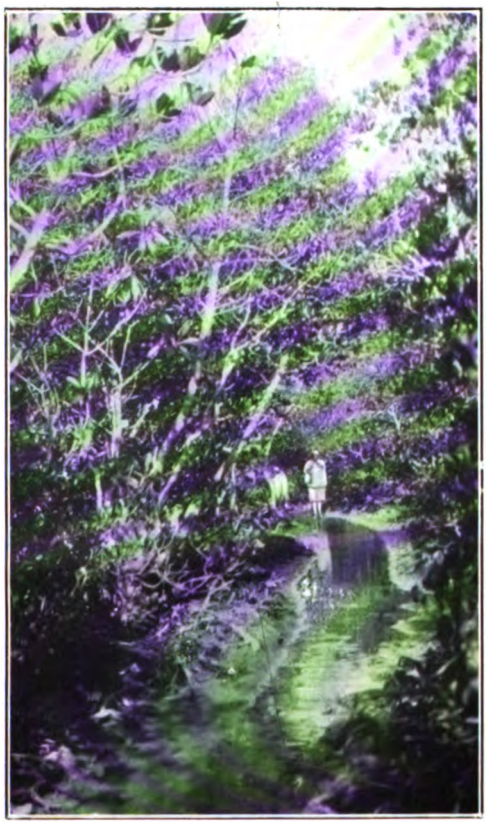
J. A. ARMSTRONG,

Lieut.-Col., R.E. (Retired).

The Editor, *R.E. Journal.*

Digitized by Google

Digitized by Google



A path through a mangrove swamp.

A main road through clove plantations.

A bush party.

Digitized by Google

THE SURVEY OF PEMBA.

By Capt. J. E. E. Craster, R.E.

Pemba is a coral island some 400 square miles in area, lying 60 miles north of Zanzibar, and forming part of the Zanzibar Protectorate. Upon it is grown more than half the world's total supply of cloves; a very valuable crop, upon which the Zanzibar Government levies an export duty of 25 per cent. The clove plantations, which cover about a quarter of the island, are owned by Arabs, who until the abolition of slavery in 1897 employed nothing but slave labour. It is said that in the flourishing days of the slave trade 14,000 slaves a year were imported into Zanzibar and Pemba, of whom the majority died within a year or two.

The natives of Pemba are closely allied to the Swahilis of Zanzibar, and speak a dialect of the Swahili language. There are also in the island a considerable number of freed slaves, who belong to nearly every tribe in East and Central Africa.

Climate.

The temperature varies but little throughout the year. The minimum cold weather temperature at night is about 74° and the maximum day temperature in the hot weather 90°. Heavy rain falls throughout April and May, and there is a second rainy season in November. Showers are of almost daily occurrence during the other months of the year, and the air is always saturated with moisture.

Preliminary Reconnaissance.

In August, 1910, Pemba was visited by Major Gordon, R.E., who made a report, and an estimate for the survey. In April, 1911, a survey party consisting of Capt. Craster, R.E., Lieut. Kyngdon, R.G.A., Lance-Corpls. Cager and Whitters, R.E., left England, and arrived in Pemba at the end of May.

Measurement of a Base.

The island is about 40 miles long, and 6 to 12 miles wide. Some 2 or 3 miles off the western coast lies a chain of small islands, and on the eastern shore of the largest of these a base had been selected by Major Gordon. Nearly the whole length of the base lay below high water mark, and the central portion below the low water mark of neap tides, so that the measurements could only be made at low water during spring tides. This involved a delay of 10 days between

Digitized by Google

the first and second measurements. The measuring party were often working in water a foot, or more, in depth, but this caused little difficulty, and had the advantage of keeping the tape at a uniform temperature.

The base was measured with a 300-ft. steel tape, and the end of each tape length was marked by a steel toilet pin stuck in the side of a wooden picket, driven firmly into the ground. The tape was stretched with a spring balance to a tension of 20 lbs. This is as heavy a pull as can be conveniently applied by hand. If tapes longer than 300 ft. are used, a heavier pull is required, and it is desirable that some mechanical apparatus should be provided for applying it.

The first measurement of the base, after making the necessary corrections for temperature, etc., gave a value of 13817·343 ft., and the second a value of 13817·232 ft. The probable error was therefore 0·4 of an inch, or $\frac{1}{373000}$ of the total length.

During the measurement of the base the party was caught in a heavy gale while returning from the island. One boat was nearly swamped, and the other, though she weathered the seas better, had still greater difficulty in getting back. The following morning all the native boys except two deserted.

AZIMUTH OBSERVATIONS.

An astronomical azimuth was observed with a 5-in. micrometer microscope theodolite at Weti, a small town on the western coast of Pemba, from which both ends of the base were visible. Two pairs of east and west stars were observed, and the value found had a probable error of 0·5″.

PRISMATIC COMPASSES.

All the prismatic compasses were tested by the observed azimuth, and the magnetic variation of each noted. The compasses varied among themselves to the extent of 1° 50′. The firm of instrument makers who supplied them reported that, owing to the difficulty of making the central line of magnetization correspond with the long axis of the needle, variations of this amount were to be expected. It is therefore essential that the magnetic variation of each instrument should be determined.

The latitude of Weti was found from astronomical observations taken with a 5-in. theodolite. Four pairs of north and south stars were used. The latitude was found to be 5° 3′ 48″·3 with a probable error of 2″·9. This latitude agreed to within 1″·5 with the latitude as shown on the Admiralty chart. The latitude observations appeared to indicate that the refraction in the southern quarter of the sky was a good deal more than in the northern; the pairs of stars which transitted at the lower altitudes giving a greater value for the latitude than those which transitted nearer the zenith.

Digitized by Google

Considerable difficulty was experienced in making the astronomical observations, owing to the sky being generally covered with clouds or haze.

Trigonometrical Triangulation.

Trigonometrical triangulation was only possible between the chain of islands and the west coast of the main island. Very few points could be fixed inland, owing to the lack of any prominent hills, and the dense vegetation. A large amount of clearing was required at each trigonometrical station, and on the average it took one day to establish each.

During the clearing operations a large tree that had been cut, but which was still held up by rubber vines, fell suddenly and broke Lance-Corpl. Whitters' leg. A telegram was sent home to the Foreign Office asking for another topographer to take Lance-Corpl. Whitters' place. Lance-Corpl. McQueen was sent out, and arrived in Pemba about three months later. By that time Lance-Corpl. Whitters had recovered from his accident, and returned to work.

Some of the trigonometrical stations were established in mangrove swamps and below high water mark, no other site being possible. At one important point a dhow sailed into the trigonometrical beacon at high tide and carried it away ; the mast of the dhow also went by the board. Fortunately all observations had been taken to and from this beacon before it was demolished.

The atmosphere was very thick, and great difficulty was found in seeing the trigonometrical beacons, especially when they were standing before a background of waving palms. Every form of beacon was tried, and the only one that proved to be visible was a straight pillar, a foot in diameter, and 10 to 15 ft. in height. These pillars were made of light wooden poles padded with grass or brushwood to the required thickness. If the background was dark, the beacon was covered with white cotton cloth, but if the background was sea or sky, the beacon was left uncovered. A large flag was placed on the top of each beacon.

Many beacons were destroyed by the natives as soon as they were erected, and the materials stolen. Native police were told off to protect the beacons, but no arrests were made. Eventually it was found that the best way of protecting the beacons was to slash the white cloth with a knife so as to render it useless for wearing purposes. An even more effective way would probably have been to splash the white cloth with red paint, which the natives would certainly have taken for blood. They regard a blood-stained cloth as "very bad medicine."

Compass bearings were taken from each new trigonometrical station to all stations visible from it, and noted in the angle books. Without this it was often found impossible for the observer to pick up the beacons with the theodolite telescope. The latter has such a

Digitized by Google

small field that sweeping for beacons is a slow business, and the strain on the eyes of the observer is very great. If the compass bearing of the required beacon is known, no sweeping is necessary.

TREE STATIONS.

At three points tree stations were constructed. A large tree was cut some 20 ft. from the ground, and the top of the stem then formed an observation pillar on which the theodolite stood. The legs of the instrument were not used. Round the stem, and some 4 ft. below the top, a platform of sticks lashed with creepers was built for the observer.

It was found necessary to cut away all the branches from round the stem, otherwise the tree shook in the slightest wind. If a tree station more than 20 ft. high is required, a very large tree must be selected, or the stem will sway a little to every movement of the observer. No one but the observer should be on the platform while observations are being taken. The observer should note whether any alteration of his position causes the cross hairs of the theodolite to move off the object. If this is so, he must observe each angle separately, taking care not to move his position during the observation. By using the reflecting eyepiece, and turning it as required, angles up to 180° can be observed without the observer moving his position, but to read both horizontal microscopes he will often have to unclamp the lower plate and swing the instrument round.

THEODOLITE TRAVERSES.

When the triangulation had been carried as far as possible, Lance-Corpl. Cager began the topography of the western coast working north from Chake-Chake, the capital of the island. Capt. Craster and Lieut. Kyngdon proceeded to run theodolite traverses across the island from trigonometrical stations on the western coast.

The traverses involved very heavy clearing, and as the clove harvest was just beginning the labour supply was very limited. Consequently progress was very slow. At first the traverse lines ran through the clove plantations, and here great care had to be exercised to select the lines that involved least cutting, as heavy compensation had to be paid for each tree cut. After the clove plantation had been left behind, the lines entered thick bush with only occasional patches of cultivation. In the thicker parts of the bush, felling the trees was not sufficient, as they lay piled up to a height of 6 or 8 ft. in the traverse clearing. It was therefore necessary to cut up each tree and remove it piecemeal. This reduced the rate of progress to about 300 yards a day.

Over the trees grew in great luxuriance a creeper bearing a fruit like bunches of white grapes. The leaves of this creeper when crushed

Digitized by Google

under foot gave out a strong aromatic scent that tainted the whole atmosphere in the neighbourhood, and affected even the native boys with a feeling of suffocation and giddiness. Another creeper bore pods covered with minute hairs that caused the pods to appear as if they were made of yellow plush. When the creeper was shaken, the air was filled with these tiny yellow hairs, which penetrated the pores of the skin and caused intense itching, and irritation.

On several occasions the traverse line had to be altered, to avoid disturbing the nests of wild bees. A professional honey gatherer accompanied the cutting party, to burn out and remove the nests, but when there were many nests close together even the professional could not tackle them.

It was not found possible to close the traverses on each other, as had been the original intention, owing to the heavy clearing that would have been required. The native boys also refused to do any more work in the dense bush belt that fringes the eastern coast of the island.

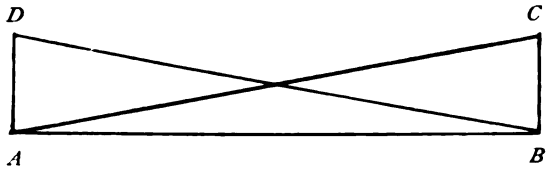
Each traverse point was marked with a permanent signal so that the topographers were able to identify it. Both forward and back vertical angles were observed with the theodolite from each traverse station, and the vertical height was calculated by the formula $h = c \tan S$; where S is half the algebraic sum of the angles observed from each end of the leg, and c is the length of the leg.

The magnetic bearing of each traverse leg was entered in the field book. This was found very useful as a rough check on the reduced bearing of the leg as calculated from the theodolite observations. If the ground had not a uniform slope between two traverse stations, a vertical angle was observed with a clinometer at each point where the slope changed, so that the taped measurements could be reduced to their true horizontal lengths.

Subtense Measurements.

When possible the length of the traverse legs was measured by subtense methods. This rendered the clearing of the line for tape measurements unnecessary, and reduced the amount of bush cutting to a minimum.

Only two signals were used in the subtense measurements. The first, distinguished by a flag, marked one end of the base and the traverse station, the second marked the other end of the base.



In the above figure A and B represent two traverse stations and AB the traverse leg. BC is the base measured at right angles to

Digitized by Google

AB and C is the subtense signal. The angle BAC was measured with a theodolite, two sets of five readings each being taken on each face. The length of AB was then worked out from the formula AB=BC cot BAC.

Before leaving A the observer measured a base AD at right angles to AB, and set up a signal at D. On reaching B, he observed the angle BAD, and found a second value for AB from the formula AB=cot DBA.

The mean value of AB was taken as the true value, but when the bases AD and BC differed greatly in length, the value of AB as found from the longer base was given the greater weight.

Subtense methods were also used for fixing prominent features which could be seen from one trigonometrical station only, and which could not therefore be fixed by triangulation.

Six theodolite traverses were run across the island. Their total length was about 40 miles and there were 218 traverse stations. The labour involved in calculating the co-ordinates and heights of the latter was very heavy.

PROJECTION USED.

The trigonometrical and traverse stations were plotted on the map from rectangular co-ordinates. As the end of the island is small no appreciable error was introduced by this method.

TOPOGRAPHY.

The island was surveyed on a scale of one inch to one mile.

Owing to the absence of prominent hills, and the density of the vegetation, ordinary plane table methods could not be used, and the following procedure was therefore adopted. Prismatic compass traverses were run between trigonometrical and traverse stations, so as to cut the country up into triangles of 3 to 5 miles side. These traverses were plotted on foolscap paper on a scale of six inches to one mile. The closing error of each traverse was distributed among the traverse stations, and the corrected co-ordinates of each station measured. The traverse stations were then plotted on the plane tables from their corrected co-ordinates, and the detail was plotted from the traverse field books.

The topographers subsequently took the plane tables into the field, and filled in all the remaining detail, and the contours, by plane table traverses run between the points already fixed. As these traverses were short, the closing errors were small, and could be adjusted in the field. The plane table was set by means of the trough compass.

As it was generally impossible to see more than 10 yards in any direction, a native boy was sent about 200 yards ahead to act as a point, and a compass bearing was taken,—or in the case of a plane

Digitized by Google

table traverse, a ray drawn,—on the sound of his voice. At 200 yards the probable error in the bearing was found to be about 2°. The error however increased very rapidly with the distance, and at 400 yards it was about 5°.

Great difficulty was found in locating the point, if high ground intervened between him and the observer. The point was therefore instructed to halt at the top of each hill. It was found that a low pitched note was much more easily located than a high pitched one, and for this reason a boy with a clear bass voice was always selected as point.

Contouring was very difficult, as no observations of any value can be taken with a clinometer on the sound of a voice. Fortunately the valley bottoms though often swampy and impassable were fairly clear and their slopes very uniform, so that it was possible to determine their general gradient by a few clinometer observations. The topographers therefore mapped the main valleys as soon as possible and marked along them the heights as calculated from their general gradient starting from the high tide mark. The heights of the hills were afterwards fixed by reference to points in the valleys. The determination of heights by aneroid readings was tried but proved a complete failure owing to the atmospheric pressure being very variable.

The country offered many difficulties to the topographers. Steep razor-backed ridges about 200 ft. in height alternated with deep crooked valleys. The bottoms of the valleys were marshy and often impassable, and tidal creeks filled with impenetrable mangrove swamps intersected the country, so that long detours were necessary. Owing to the nature of the work the topographers could only survey half a square mile a day. Much time was also lost from wet weather.

The slow progress made by the topographers, and the urgent necessity of completing the work before the rainy season made it essential for the two officers to undertake a considerable part of the topography. In addition to running many of the prismatic compass traverses for the topographers, they mapped some 70 square miles of the island.

As a rule it is not desirable that officers should do topography, because it is work that can be done by non-commissioned officers and men who are of course on much lower rates of pay, and when an officer is employed as a topographer he cannot exercise enough supervision over his party. But owing to the heavy demands for trained topographers, foreign survey parties must generally be satisfied with the minimum rather than the most economical number.

The area of the island was originally estimated at 300 square miles, and the time allowed for the survey was eight months. An area of 300 square miles was surveyed within the time allowed, but the island proved to be about 400 square miles in extent, and the survey took 9½ months.

Digitized by Google

NAMES.

Great care was necessary to obtain the correct names of the various districts and villages, as the common pronunciation often gave no clue to the spelling. Many of the villages had opprobrious names, such as "The Fools," "Fly Blown," etc., which the inhabitants would not admit, but which were used with gusto by their neighbours. One little congregation of poverty-stricken huts was endowed with a name which meant "Because I have nothing my brothers won't visit me." Lists of all names that would appear on the map were made out and forwarded to the Assistant Collector of the district who, after consultation with the headmen, wrote the correct form against each name.

LONGITUDE SIGNALS.

An attempt was made at the end of the survey to determine the longitude of Chake-Chake, the capital of the island, by wireless telegraphic signals from Zanzibar. The attempt failed owing to continuous atmospheric discharges, due to thunderstorms over the mainland of Africa, which made themselves heard on the wireless receiving telephone, and which were indistinguishable from the time signals. It often seemed as if the wireless signals themselves provoked atmospheric discharges, for the latter often came as an echo to the former. Perhaps it is possible that a cloud which is already fully charged may receive from the wireless signal an additional charge which is sufficient to break down the insulation of the atmosphere, and cause the cloud to discharge itself.

Even under the best conditions, the wireless telegraphic apparatus is not very suitable for longitude signals. It is almost impossible to send a short sharp signal, as the heavy currents used produce an arc at the contact points of the signalling key, and so prolong the signal for an appreciable interval after contact has been broken.

Chronometers installed in a wireless telegraph station are sure to be affected by the heavy currents, and strong magnetic fields, and cannot, therefore, be expected to keep a uniform rate.

INSTRUMENTS.

Two 5-in. micrometic microscope theodolites made by Messrs. Troughton & Simms were used during the survey. The sights on these instruments are rather crude, and at night it is difficult to align the telescope by them. In other respects the theodolites are very perfect instruments.

Four-inch prismatic compasses, graduated to 30′ and reading by estimate to 10′ were used. These were mounted on light tripod stands, and proved very satisfactory. The Indian clinometers which were of the standard pattern, gave some trouble, because they contained so much steel that they deflected the compasses if in their

Digitized by Google

vicinity. The plane tables were 24″ × 18″ in size and mounted on heavier and more rigid legs than are usually supplied.

Two measuring wheels (perambulators) were taken out, but could not be used as the paths were too rough. The party was equipped with heliographs, but the cloudy weather prevented their use.

Great difficulty was found in preventing the steel measuring tapes from rusting. The only way to preserve them was to fill up the leather case with paraffin oil at the end of each day's work. It would be a great advantage in damp climates to have a small oil tank in which the tapes could be stored, when not actually in use.

Tools.

Axes and saws were purchased in England. Large bush knives were obtained locally in Zanzibar. When much clearing has to be done it is best to issue an axe and knife to each boy, and let him keep them till the work is finished. He then takes care of them, and keeps them well sharpened. For heavy bush clearing about one-third of the party should be equipped with felling axes, and two-thirds with hand axes. Axes to be used by natives should be of the lightest English pattern.

Much trouble was experienced in fitting new helves to the axes, as the sockets in the steel heads were very small, and the native wood helves had to be whittled away to fit the sockets. The new helves in consequence broke off at the socket after a few days' work. Spare ash helves were taken out, but these became dry and rotten before they were required for use.

Large cross-cut saws with teeth set very wide proved extremely useful, when once the native boys had learnt to handle them.

Many of the boys carried sheath knives with blades about 6 in. long. For cutting creepers and small brushwood these were much more handy than the large bush knives, and it would have paid to have equipped the whole party with them in the first instance.

Camping Arrangements.

Each officer and non-commissioned officer was equipped with a double fly ridge tent, camp furniture, cooking utensils, and a filter, so that he could camp alone if necessary. In addition there were two mosquito-proof houses ; one for the officers and one for the non-commissioned officers. The houses consisted of a mosquito curtain 8 ft. × 8 ft. × 8 ft. in dimensions. A small sheet 12 ft. × 12 ft. × 8 ft. thatched with palm leaves was built at each camping ground, and the mosquito net hung from the rafters. The windward sides were filled in with palm leaves to keep out the driving rain, but the leeward sides were left open. Without these mosquito-proof houses it would have been impossible to do any work after sunset, and there is no doubt that they saved the party from a great deal of fever.

Digitized by Google

Encouraged by the example of the survey party, one of the Zanzibar Government officials employed by the agricultural department to supervise the gathering of the clove crop camped in the interior of the island for some months, but did not use a mosquito-proof house. He suffered from repeated attacks of fever, and died in Zanzibar a few days after leaving Pemba. With the exception of the survey party no other European has ever attempted to camp for more than a few nights in the interior.

Owing to the very heavy dews and frequent rain, the native boys and servants could not bivouac as they do in most parts of Africa. Native huts were therefore hired for them, and when these were not available thatched huts were built.

HEALTH.

Five grains of quinine a day were taken by every member of the party as a preventive, but all suffered from malaria. There were no cases of blackwater fever, though it is very prevalent in the island, and often follows an attack of malaria, if the patient returns to work too soon. The doctor therefore gave instructions that no malaria patient should return to work, until four or five days after the fever had left him.

Two of the party suffered from severe congestion of the liver accompanied by high fever as the result of chills. It has been suggested by a doctor of considerable African experience that these attacks may have been due to the bite of a tick, which produces similar symptoms in animals. This is a disease that only a doctor can diagnose, and if the proper remedies are not applied early, abscess of the liver is likely to follow.

Owing to the necessity for finishing the survey before the rainy season, it was necessary to work 10 hours a day for seven days a week, and at the end the whole party were much exhausted by the hard work and the effects of malaria. In fact 10 months may be taken as the maximum time that a European surveyor can work at a stretch in the unhealthier parts of Africa. At the end of that time he should have at least two months' rest in a bracing climate before he returns to work.

The completion of the survey before the rainy season was due entirely to the zeal and energy displayed by Lieut. Kyngdon and the three non-commissioned officers. Had the rains broken before the outdoor work was finished, the survey would have been prolonged for another two or three months, and the cost would have been increased by not less than 20 per cent.

Digitized by Google

THE MILITARY ARCHÆOLOGY OF KENT.

From a Lecture delivered at the School of Military Engineering on November 16th, 1911, *by* MAJOR A. M. HENNIKER, R.E.

IF officers, as of course they all do, make a point, every night before going to bed, of reading a chapter of their *Field Service Regulations*, they have without doubt come across the expression "strategical point." But however carefully they read those *Regulations* they will nowhere find any explanation of what a strategical point is. It is one of those things that everyone knows—until they are asked. And if you ask some expert on such subjects "What *is* a strategical point?" it is quite possible that the answer may be "What, not know that? You are an ignorant fellow. I thought everyone knew that. Why, of course it's—it's—it's a point of strategical importance! Well, I'm awfully sorry, old man, but I'm busy to-day. If you will come back after next year's manœuvres I'll tell you all about it." Now archæology and modern military science do not seem to have very much in common, but anyone who takes any interest in the military antiquities of the county in which he is quartered can hardly fail to be struck by the fact that certain places have been fortified at every period from the very earliest times. Rochester was fortified long before there was a dockyard at Chatham to defend—in prehistoric times, by the Romans, by the Saxons, the Danes, the Normans, and in mediæval times. Canterbury is perhaps an even better example. There are earthworks there dating from the Stone Age; in the early Iron Age the largest earthwork in the county of Kent was constructed in the immediate neighbourhood; the Roman camp there was the hub on which the whole system evolved by the Romans for the coast defence of Kent turned; the Normans thought the place of sufficient importance to build there the third largest Norman keep in all England; and as late as 1790 when the Government of the day was building barracks to house the troops that had come home at the close of the American War of Independence, Canterbury was selected as a suitable place for what was then one of the largest garrisons in the country. There are, I think, quite a number of useful lessons to be learnt by considering some of the military problems that the inhabitants of Kent at various periods have had to face, and the steps they took to solve them.

Before we can consider the military problem in prehistoric times

Digitized by Google

we must form some idea of what the country was like in early days. First, the whole of the interior was covered by the great forest known in later days as the forest of Andred, 30 miles from north to south and 120 from east to west, stretching from the high ground above Folkestone right away into Hampshire. The centre of Kent is still called the *Weald* of Kent, which is only the Saxon name for the forest. The forest itself lasted until quite modern time ; its influence on the topography of the country remains still. As late as 1802 the engineer Rennie describes the centre of Kent as possessing no roads but only tracks used by smugglers. The country being more wooded the rainfall was heavier and the rivers larger. Much of the low-lying ground along the courses of the rivers was impassable marsh—in the Weald for instance and along the Stour from Ashford to Canterbury. Before the days of bridges the rivers were only passable at a few fords. Great changes have taken place in the coast line. It is an interesting study, closely connected with the modern question of coast erosion, but there is not space to go into it in the present article. Thanet is still an island, but without some exploring it is not easy to say exactly where you pass from the mainland of Kent on to the island of Thanet. Yet even in the 8th century the Wantsum, the channel dividing Thanet from the mainland, though much shrunk was still 600 yards wide. The name Stourmouth shows that in Saxon times the mouth of the river Stour was at a point now 4 miles inland. Dungeness did not exist. Oxney Island is still surrounded by water but the water is fresh ; the island is 5 miles from the nearest sea. Only one road existed, the track by which perhaps the ancient Britons brought tin from Cornwall for shipment across the Straits of Dover to the Continent, the road which in much later times received the name of the Pilgrims' Road by which it is still shown on the Ordnance maps. The population, confined by the forest to the coast line, was very small and scattered.

Now what form of attack had the inhabitants to provide against ? The enemy whether coming by land or by sea had no Field Companies of Engineers or Bridging Train ; he could cross the rivers nowhere but at the few fords. And he had no Transport and Supply Columns to provide him with food ; he had to live on the country. An invading force could only support itself on what it could collect from the local population. When that was consumed it had to move on or starve. It could never sit down and besiege a place. Suppose now that the defenders collect their cattle and their corn into defensible entrenchments. What can the invader do ? If he cannot capture such a concentration camp by assault he must immediately move elsewhere in search of food. And by assaulting he is surrendering the initiative ; he is doing just what the defender wants. The defender has selected and prepared a place where the advantages are

Digitized by Google

all on his own side and is compelling the invader to attack him there. Most of the prehistoric earthworks in Kent seem very badly supplied with water. One reason I think is that they were not intended to be occupied for more than a day or two at a time. And some at least of them are provided with special enclosures for cattle.

Plate I. is a map of early Kent. On it are marked a number of British camps. Possibly it may be said that it is incomplete or that it contains some works not constructed until much later times, but it is a list made out not long ago by a competent authority and we will accept it. We cannot go into everything shown on the map but will take one small part as a sample. Notice the line of earthworks marked 2, 3, 4, and 5, so regularly placed about 5 miles apart. Suppose pirates landed anywhere along the coast between Deal and Folkestone. All the population except that in the immediate neighbourhood of the landing place is nearer one of these earthworks than the invader is. At the first alarm the women, cattle, and corn would be removed to the nearest shelter while the men collected to meet the invader and forestall him at any entrenchment for which he might make. With all the food of the country swept up into these camps he could only retire to his boats, move inland, or starve. And suppose the invader moves inland; he is brought up by the river Stour. He cannot get up to its upper reaches because of the forest. From the forest to its mouth it ran through impassable marsh. The only way by which he could cross was by a ford at Thanington, near Canterbury. As long as that was held securely the whole of the country west of the Stour was safe. Similarly with an invader coming by land. If that ford near Canterbury was held all the country east of the Stour was safe. The importance of the place is obvious. Overlooking it the ancient Britons constructed the largest earthwork in the county. It was in fact a point of the utmost strategical importance. Applied to a concrete case the meaning of "strategical point" is clear.

Let us pass on to the next era (*Plate* II.). Under Roman rule Kent enjoyed peace for 200 years, but about the year 250 A.D. it began to be subject to raids by bands of roving pirates from northern Europe. To protect the county the Romans evolved a highly organized system of coast defence. Half of the garrison hitherto employed to guard against inroads from Wales was brought east and quartered in four great fortresses—Reculver, Richborough, Dover, and Lympne—and these great garrison towns were linked up by 80 miles of paved road which form the groundwork of the roads in eastern Kent to-day. Imagine the thoroughness and tenacity of purpose required to think out such a disposition of forces and then to build the fortresses and construct the roads. We ourselves are doing something of the same kind at the present day on the north-west frontier of India. Notice the distribution of the garrisons and the skilful arrangements by which

Digitized by Google

a force could be rapidly concentrated anywhere on the coast or at Canterbury. The map shows the garrisons towards the end of the Roman occupation of Britain, when they were cut down to the lowest limit by the withdrawal of troops for service nearer home. The Roman garrison of Kent was just like one of our colonial garrisons at the present day. Just as we have a High Commissioner to look after our interests in the Mediterranean, so the Romans had an official commonly called the "Count" of the Saxon shore. He had a staff just like ours—a chief staff officer, a military secretary, two staff captains, and so on. The headquarters of the Eastern Coast Defences were at Richborough. Military life at a colonial station was very much the same then as now. We read of medical officers who no doubt prescribed mixtura diabolica to patients suspected of shamming; of auditors who no doubt ruled that when young centurions went down to the treasury to draw the pay of their centuries they must travel two in a quadriga.

Inside each fortress were the barracks, officers' quarters, canteen, offices, and the stores. In the cornfields outside Richborough, in a dry summer when the corn is ripening, to this day you can trace by its stunted growth the streets of the Roman Old Brompton.

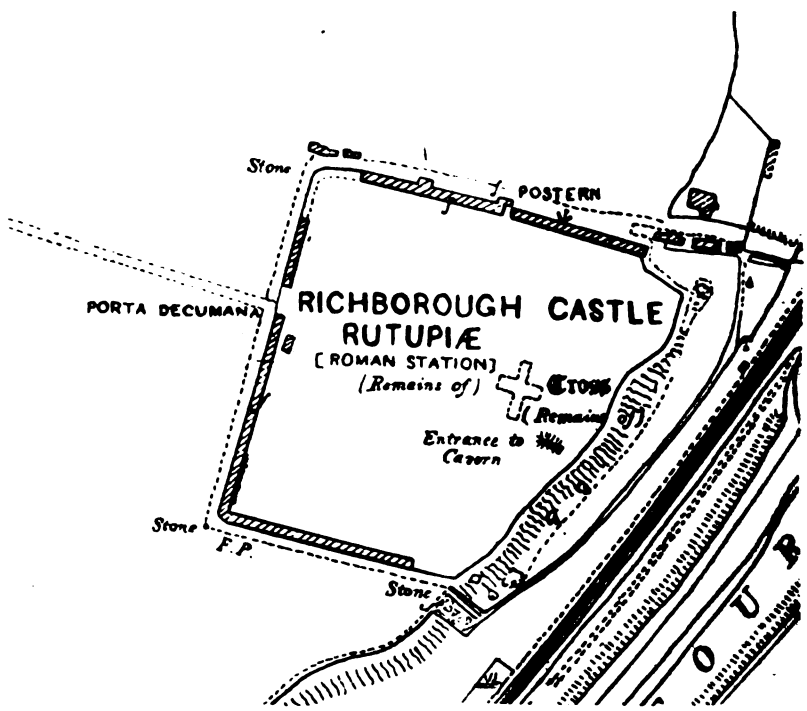


FIG. 1

Digitized by Google

Fig. 1 is a plan of part of the fortress of Richborough—the one with the best harbour and the principal port of cross-channel traffic. It was then on an island; now part of the fortress has been cut away by the river Stour. Archæologically the great interest of Richborough lies in the dotted cross shown inside the walls of the fort. It marks the site of a huge mass of buried concrete, 144 ft. long by 104 ft. wide. How deep the mass goes is unknown; water is reached 29 ft. below the surface but not the bottom of the concrete. All sorts of theories have been advanced as to its object but space is not available to go into them; the most likely solution appears to be this. When the Roman garrison left in A.D. 411 they thought they were going on a short summer campaign and would be back again in garrison before winter. Bede, who wrote within 300 years of the time they left, tells us that what they did not want to take with them on active service they buried, and that no one had ever been able to get at it. Suppose that the garrison of Chatham was ordered on service and the barracks were to be shut up and left unguarded; and that arrangements were made for all the peace equipment, everything in fact which could not be taken on active service, to be stored in a large secure storehouse. What would we expect to find in such a store? There would be spare arms and clothing, garrison and regimental archives, the plate from the Officers' Mess, the trophies from the N.C.O.'s Mess, the more valuable personal belongings of officers and men, and many other things. It is quite possible that that mass of concrete contains to this day the Roman equivalent of all that.

Under three centuries of Roman rule the Britons had lost the power of self-defence, and when in A.D. 411 the Romans left for good and the Roman garrisons which had guarded them from invasions from Scotland and Wales were withdrawn, they fell an easy prey to the Picts. Unable unassisted to defend their own country they struck a bargain with those same Saxon pirates against whom the Romans had erected the great fortresses in the south-east. In 449 they called to their assistance a band of roving Jutes under the leadership of Hengist and Horsa, promising them the island of Thanet in return for their military services. Thanet no doubt was chosen as particularly suitable. Settled there the Jutes would be cut off by an arm of the sea from the rest of the British territory and under the watch of the two great fortresses on its banks. The Picts were easily defeated by the Jutes, so easily in fact as to suggest to the conquerors "if these can defeat the Britons so that they have to call upon us for assistance, how easily can the Britons themselves be overthrown by us. Why should we be content with Thanet when we can have the whole country for the asking?" Under what pretext they attacked their paymasters and how they avoided the fortresses

Digitized by Google

overlooking them we do not know. But attack they did, and swept up the great Roman highway through Canterbury towards Rochester. The fortifications of Rochester turned them southwards to find another crossing place of the Medway, and at Aylesford they found the Britons waiting to dispute the passage. All we know of the fight is that it was costly to both sides; the invaders carried the ford but lost one of their leaders, Horsa. A point of interest to us at Chatham is that his name survives in that of the modern Fort Horsted, which stands on or near the site of the tumulus which tradition reports to have marked his tomb. Next year the invader penetrated further into Kent and again met the defenders at a river crossing, this time at Dartford. Though the defenders lost heavily the battle seems to have been a drawn one, for next year we find the same forces again fighting for possession of the same ford. This time the invader was completely successful; 4,000 of the defenders fell and the *Saxon Chronicle* records that "the Britons then forsook Kent and in great terror fled to London." A year or two later the fortresses of Richborough, Dover, and Lympne fell into Saxon hands. Meanwhile the invaders were slowly pushing their way along the coast south of the Weald, and with the capture of Anderida in 491 the whole of the south-east passed into their hands. In the brief words of the *Saxon Chronicle* again "Aella and Cissa beset Anderida, and slew all that dwelt therein, so that thereafter was not one Briton left there." The lesson I think is this. The finest fortresses and the most perfect communications are worth nothing unless they are held by a warlike race. You sometimes hear people say that if only we spend enough money on fortifications we can make the country perfectly safe. The Britons had all the advantages of ready-made defences of the most perfect type of the day, but they availed nothing against a hardier race. National safety depends on a nation's spirit, not on its fortifications.

And these campaigns illustrate the importance in early times of river crossings. Nearly every one of the fords in Kent (Catford, Crayford, Dartford, Eynsford, Otford, Rochester, Aylesford, Canterbury) has been the scene of one or more pitched battles. Another point worth noting is that it is generally the crossing nearest the mouth of a river that is the most important. Watling Street, the great Roman road from Dover and Richborough into Wales, crosses every river on its route through Kent at what was the lowest crossing place in Roman times; it aims at Westminster, then the lowest ford on the Thames, and thence it aims for Wroxeter, the lowest ford on the Severn.

The Saxons drove out the Britons; in their turn the Danes overthrew the Saxons. For 230 years—from 787 to 1016—Kent was in a chronic state of war. Though there is much of local and

Digitized by Google

archæological interest in the Danish campaigns, the fighting was too desultory to be of much military interest at the present time. Sometimes the Danes besieged Rochester; sometimes they were themselves besieged there. Alfred began a great campaign by an attempt to prevent the junction of two Danish armies which landed, one at Milton near Faversham and the other at Appledore. His scheme was frustrated by administrative difficulties and by the wooded and marshy nature of the Weald, and the issue of the campaign was fought out on the borders of Essex and Middlesex. The secret of the success of the Danes lay in their mobility and their sea power. They brought horses from over-sea with them, and collected more after landing. Whenever they won a victory almost invariably the first condition imposed on the defeated side was that they should furnish remounts. And whenever they themselves were pressed and in danger of defeat they "take horses and ride where they like," or they "ride away by night" to the coast and are transported by their fleet beyond the reach of pursuit. Alfred recognized the want of ships, but a navy cannot be built in a day. He himself designed and had built ships not merely capable of meeting the Danes at sea on equal terms, but ships both larger and more efficient than any built before. He has been called the father of the English Navy; he might almost claim to be the first inventor of Dreadnoughts. In many other respects he was far in advance of his time. His military organization contains the germ of the modern system of a standing army with reserves.

The next great invasion which threatened the shores of Kent was that of William of Normandy. There are few periods of English history more dramatic than the short reign—40 weeks and 1 day—of Harold. Harold was confronted with most difficult problems, political, strategical, tactical, and in the administration of his military forces. And his history is well worth our study because in many respects the problems he had to solve are identical with those which our General Staff have to consider at the present day. Besides isolated raids anywhere round the coast, he had to provide against invasion by a large army of highly-trained Regulars in the south, while another army of unknown strength made a diversion in the north. For the defence of his kingdom he had to rely on a large army of Territorials stiffened by a small nucleus of Regulars. Like ours, his Territorials were excellent fighting men individually, but they had not the discipline and cohesion which only long training together can give. He did not dare trust them to meet the southern invader in the open field. His strategic aim was to seize some point which the Normans could not disregard, so that they would be obliged to attack him on ground selected by himself and entrenched. And his solution of all the problems that beset him was eminently

Digitized by Google

successful. He collected at Sandwich in Kent the largest army and the largest fleet ever assembled in the history of the country before. And he kept it under arms, and fed it, for just three times as long as the military organization of the day contemplated. Then, after a forced march of 270 miles he surprised and defeated one invader at Stamford Bridge, near York. Within three weeks, after another forced march of 240 miles, he seized a point such that the Normans had no option but to attack him there. And his final overthrow, and death, were due, not to any mistake on his part, but solely to a momentary want of discipline on the part of his Territorials. In the very moment of victory, carried away by their own enthusiasm, they disobeyed their orders, and the result was utter disaster. Not with any idea of unduly exalting his achievements, but merely to show that there may be something of military interest even at the present day in the events of those last five weeks of Harold's life, the following particulars of his two great marches are given :—

A.D. 1066.

Harold leaves Sandwich	Sept. 8th.
Defeats Harold Hardrada at Stamford Bridge, near York	Sept. 24th.
(266 miles; average 16½ per day).	
William lands at Pevensey	Sept. 28th.
Harold hears of the landing	(?) Oct. 1st.
Harold's troops in position at Senlac	Evening of Oct. 13th.
(243 miles; average 20¼ per day).	
Battle of Senlac. Harold killed	Oct. 14th.

Napoleon's Grand Army, 1805, the Channel to the Rhine—
400 miles in 25 days = 16 m.p.d.

Sherman's march, 1864, Atlanta to Savannah—
300 miles in 24 days = 12½ m.p.d.

Lord Roberts' march, 1878, Cabul to Candahar—
232 miles in 15 days = 15½ m.p.d.

For 140 years after Harold's death England was ruled by foreign kings. The Kings of England were Dukes of Normandy as well. And on whichever side of the Channel they happened to be there was always a danger of a rising against their authority on the other. On the English side therefore they needed, first, secure harbours on the south coast into which their despatch vessels, and if necessary their transports, could put safely; next, safe roads inland from those harbours, with every point where the roads were liable to inter-

Digitized by Google

ruption garrisoned by their own forces; and in London a fortress to overawe the capital, and an arsenal and base if necessary for operations further inland. The work of fortifying the important points was entrusted by William the Conqueror to his great military architect, Gundulph. In the library of the Royal Military Academy at Woolwich is a tablet with a list of distinguished officers of the Corps of Royal Engineers, and the first name on that list is Gundulph. Of his original work not much remains in Kent, but the military importance of the places he fortified is shown by the fact that within 80 years of his time every one of them had to be enlarged or strengthened. Every one of them at one time or another has shown by the attacks made on it the importance it possessed in giving to its holder some definite military advantage. The holder of Rochester Castle secured for himself a free passage across the Medway and denied it to his enemy; within 300 years of the time the Norman castle was built it was besieged six times.

A few examples of Norman castles are: (1). Pevensey Castle, a Norman keep standing inside the Roman fortress of Anderida. Pevensey of course is in Sussex, not Kent, but it is of military interest in so many ways that mention of it needs no excuse. The castle is a mile inland now, but the fact that the Roman walls are built on piles reminds us that it originally stood at the waters' edge of a great harbour. It was here that William disembarked his army, and for some hundreds of years after it remained one of the principal ports of passage to the Continent. (2). Dover Castle, the great square keep built in 1155 standing in a walled enclosure of every date from Roman to modern times. (3). Canterbury Castle, the third largest Norman keep in England, now used by the local gas company as a coal store. (4). Rochester, which is too well known to need any description. The remains of Gundulph's original tower are inside the Cathedral enclosure. (5). The great White Tower in the Tower of London, the only perfect example of Gundulph's work extant.

In the 300 years following the Norman invasion many feudal castles were built in Kent and numerous Kentish towns were fortified with masonry walls. Such works are not of great interest from a military point of view except in one particular way. They represent the culminating point of the art of fortification prior to the invention of explosives. On the north-west frontier of India, in Burma, in Africa, and elsewhere we have numbers of posts designed to be defensible against an enemy unprovided with artillery. During the South African War after the Boers had lost all their artillery we put up a considerable number of solid stone blockhouses. Any one who has to design such a work may pick up some useful hints from mediæval examples.

Digitized by Google

Let us pass on to the next noticeable period, the reign of Henry VIII. Prior to his time the towns along the south-east coast had fortified themselves under penalty of being burnt by the French. Henry was, I think, the first to take a comprehensive survey of the coast defences of the country as a whole. Working on a definite plan he caused them all to be overhauled and a number of entirely new ones to be constructed. And the new ones were not necessarily near towns at all; many were sited to protect possible landing places and to deny to an enemy the use of various harbours. The effect of the growing power of artillery is seen in the massiveness of his castles; in strength and solidity they were a great advance on any previous coast defences. It says much for the ability and foresight of his engineers that though in the succeeding 300 years his works were often overhauled and extended, yet no further great scheme of building permanent works was undertaken until the invention of rifled guns combined with a French scare led to the Royal Commission on Coast Defence of 1859. Several of his new forts—*e.g.* Hurst Castle and Southsea Castle—are the nucleus of present-day coast batteries of the same name. Four were erected in Kent—Sandown, Deal, Walmer, and Sandgate; a fifth, Camber, lies just over the border in Sussex. They are all very similar in plan, a large circular keep in the centre surrounded by five or six circular bastions connected by curtains.

Camber is now almost a mile from the sea, but it is said that when it was erected the largest ship afloat could lie within biscuit toss of its walls; yet within 100 years Charles I. ordered it to be sold as being too far inland to be of use. On the other hand the Royal Commission on Coast Erosion in their final report recently published say that War Office records show that when constructed Walmer, Deal, and Sandown Castles were all a quarter of a mile from the sea. One hundred and fifty years ago they had to be protected from the sea. The width of the shingle bank along the coast here is constantly varying; in front of Walmer and Deal it is now I think two or three hundred yards. Sandown has been almost entirely washed away; only a small part of one bastion remains.

Though Henry built forts, he was wise enough to build ships too, and the great outburst of naval activity which began in his reign culminated at the time of the Spanish Armada. We know now that the Armada planned to sail up the Thames and land 50,000 men. We know too that from mismanagement and other causes, even if it had not been beaten at sea it could hardly have landed even 30,000. At the threat of its coming all the defences of the south coast were overhauled, fresh guns mounted, and garrisons provided. We hear of a battery being contemplated on the site of the Gunwharf (at Chatham); a chain was stretched across the Medway from

Digitized by Google

Upnor Castle; guns were mounted at Cooling Castle, and so on. Twenty thousand men garrisoned the defences of the south coast, 23,000 were camped at Tilbury and Gravesend, 34,000 formed the army of reserve. The Lord Lieutenants were given powers of "driving" their counties, that is to say of forcibly removing to secure places inland all the inhabitants, corn, horses, cattle, and forage, immediately the invader landed, recalling the prehistoric system of defence.

To ensure the rapid transmission of the news of a landing all over the country an extensive system of beacons was arranged; there were over 50 stations in Kent alone (*Plate* III.). All about the county you will find a number of eminences marked on the Ordnance maps "Beacon Hill"; there is one on Chatham Hill (near Jezreel), on the south side of the main road from Chatham to Dover; another 2 miles west of Faversham, and another near Benenden. Most of these got their name I think in Armada times. The intention was to signal a landing by smoke by day and by blazing tar barrels by night. In the event of invasion we might even at the present day have to depend for a time on visual signalling. Does the signalling officer of the emergency battalion at Chatham know the best places at which to establish signalling stations to communicate with, say, Canterbury, or the great defensive position near Sutton Valence, or even Gravesend? If not he might do worse than put in his pocket a map showing the positions of the Armada beacons.

For nearly 200 years after the time of the Armada the military history of Kent records no striking events. The capture of Sheerness and the burning of ships in the Medway in 1667 was not an invasion but a purely naval raid. It is not until the 18th century that we begin to hear of invasion projects and defence schemes. From 1773 onwards the problem of the defence of Kent from invasion increased yearly in importance. During the American War of Independence most of our regular troops were abroad, and in 1778 we find camps of militia at Dartford, Chatham, Coxheath (just south of Maidstone), and at Warley, in Essex. The French General Staff published some years ago a large work giving particulars of every French scheme for the invasion of the British Isles down to the time of Napoleon. The scheme of 1778 was worked out by General Dumouriez, then Commandant at Cherbourg and afterwards Minister of War and Commander-in-Chief. At the time of the French Revolution he left France and placed his services at the disposal of the British Government. For their benefit he gave full details of his scheme of 1778 and these are shown on *Plate* IV. Space only allows of noticing one or two points in it. The various columns are shown at the places at which they were to camp each night. The daily marches are short, averaging only about 8 miles, no doubt because opposition was

Digitized by Google

to be expected. In some cases the places at which he proposed to halt were actually the sites of militia camps at the very time the scheme was prepared. One wing was to move *viâ* Rochester; the Great Lines as we know them at Chatham and the land defences of Rochester were just being started. If Dumouriez knew of them he probably counted on their being so incomplete as to be able to offer little resistance. If you try to put each day's march on a modern map you will find that the roads are very inconvenient; there is seldom a good road from one halting place to the next. The reason no doubt is that in 1778 there were very few roads in the Weald at all; the marches were cross-country ones. The decisive battle was expected to take place on the sixth day, along a line from Forest Hill to Deptford. It was just about the time that this scheme was prepared that three floating bridges were constructed at Gravesend to enable troops to be readily transferred from Essex to Kent or *vice versâ*. In the event of invasion such bridges might play an important part at the present day. Suppose a Territorial Division is mobilized at Warley, in Essex, and another say at Trosley, on the chalk ridge overlooking Kemsing and Wrotham. Suppose further, an invader lands in the south and it is desired to bring the division in Essex to reinforce the division in Kent. The distance is only 20 miles as the crow flies and with bridges at Gravesend it would be only a single day's march. If the movement were to be effected by railway *viâ* London it could hardly be completed in less than three days.

After the year 1778 the regular troops who had been serving in America began to return home and barracks had to be built for them. The south-eastern district was the danger spot and we find barracks being put up at Chatham, Canterbury, Deal and Rye. There was a proposal to purchase Rochester Castle and convert it into barracks. But a large number of troops were still kept under canvas along the coast during summer and withdrawn inland and billeted during the winter. We hear of complaints by the civil population of the hardships caused by billeting, and a military writer of the day points out that it would be much better if the troops were kept near the coast, not for defensive reasons, but because they could be fed so much more cheaply near the sea on fish! The number under canvas was often very considerable; as many as 15,000 were camped near Brighton in 1793 and 1794. In 1796 George III. wrote to the Commander-in-Chief pointing out the danger of their withdrawal in winter and recommending temporary barracks at Canterbury, Ashford, and Chelmsford. Napoleon was well aware of the withdrawal in winter. In 1798 he wrote that an invasion carried out in the months of November or December would almost certainly be successful. At the present day if the Territorials were called out in the winter the problem of how to house them would be a serious

Digitized by Google

one ; you cannot billet say 20,000 men in one place for six months at a stretch.

In 1796 the expected invasion appeared imminent and the Cabinet called upon the War Office to formulate a defence scheme. The War Office, after some search, produced it—from the Public Record Office ! It was the scheme drawn up at the time of the Armada 200 years before. This of course was quite unsuited for the new conditions and Sir David Dundas, the Quartermaster-General, drew up a new one. From this time until after Trafalgar in 1805 the scheme underwent constant alteration, so that it is difficult to say what the arrangements in force at any particular date were. Space is not available to trace its evolution, and it will only be possible to touch on one or two points.

At first it was intended to " drive " the southern counties immediately a landing was effected, *i.e.* to withdraw inland all the inhabitants, live stock, corn, forage, and vehicles. The district was mapped out into areas each under a commandant and places of concentration selected. But when worked out in detail the scheme proved quite impracticable. Sussex alone needed 18,000 wagons to remove the corn and 35,000 to remove the hay, while in addition there were 60,000 aged and infirm persons to be removed. At least 110,000 draft animals would have been required while all told there were only 37,000 horses and oxen in the country. It was decided therefore that all that was to be attempted was to remove all the horses and vehicles and to burn the corn mills. An enormous number of works were undertaken to protect every possible landing place ; although in recent years the War Department has disposed of a great many pieces of land yet it still possesses plots, originally the sites of batteries, practically every half-mile all round the coast of Kent and Sussex. Many of the works were not completed till long after the danger was past.

It is interesting also to consider the mobile defences. What was Napoleon likely to do ? We know now that he had in French ports ready to embark at an hour's notice 90,000 men with over 400 guns and rations for 10 days. He calculated that the crossing would take from six hours to three days according to the state of the wind and tide, and that he would reach London four days after his landing. On his way to St. Helena he made three statements as to where he proposed to land. (1). Between Deal and Margate. (2). As near Chatham as possible. (3). Wherever it suited, preferably on the coast of Kent. He reckoned on securing Chatham as a point of retreat if defeated on land. Dundas, who commanded all Kent and Sussex with his headquarters at Canterbury, based his scheme of defence on suppositions that we now know were quite wrong. He concentrated his principal defences between Dover and Beachy Head. Apparently he did not anticipate a landing by more than 40,000 men.

Digitized by Google

Dumouriez thought that Kent could be made secure by 60,000; the Duke of York, Commander-in-Chief, thought 55,000 would be enough for both Kent and Sussex. Actually the regular mobile defence was divided into three armies, one 30,000 strong in Essex, one of 15,000 in Kent, and the third, also 15,000 strong, in Sussex. Each was supplemented by large numbers of local volunteers.

On the assumption that the invader would attempt to land west of Dover, and that he was successful, Dundas' plans were these. News of the landing was to be disseminated from his headquarters at Canterbury by beacon fires on 15 or 16 of the most conspicuous hills in Kent. His right and centre were to be drawn back on his entrenched camp at Dover; if disregarded he would press on the invader's right flank and rear. Chatham being held, the invader would have to move on London *viâ* Maidstone, through a marshy and wooded country unfavourable to his cavalry, with few roads, such roads as there were being broken up. The force in Sussex, 18,000 strong, was either to be moved in carts to reach the great chalk ridge before the invader, or to hang on his left while he was embarrassed in the Weald. The army in Essex was either to cross at Gravesend (by the floating bridges) or retire on London. In 1796 he thought the best line of defence near London would be along the Ravensbourne, through Dulwich to Norwood. In 1803 the Duke of York thought that 500 men with 300 horses could in three days entrench a line from Blackheath to Wandsworth. Later again Dundas considered that the best line of defence would be on a line from Greenwich through Southwark to Lambeth, the defenders being relieved from time to time as fresh combatants arrived from the country. One cannot help thinking that there was something radically wrong with his whole scheme. He justified it on the ground that it would be "madness" to meet the invader, even on the great chalk ridge, with the troops under his command—they were not good enough. But what Dundas had to expect then, is very much what, if invasion does come, we may expect at the present day. An invading force will be composed of picked and highly trained Regulars, capable of marching at least 25 miles a day. If the defenders draw off to a flank as Dundas proposed, they will never see the enemy. He will march straight ahead and they will never catch him.

In connection with the fixed defences at the beginning of the 19th century was a system of visual telegraph stations. There are several places in Kent called "Telegraph Hill," "Telegraph Farm," and so on. There is a Telegraph Hill near Minster, in Thanet; another near Higham, between Strood and Gravesend; there is a Telegraph Farm near Tilmanstone. These got their names in Napoleonic times, when the Admiralty organized lines of signal stations along the coast and from various places such as Sheerness,

Digitized by Google

Deal, and Portsmouth to London. In London there was a station at first on one of the towers of Westminster Abbey and later on the top of the Admiralty Offices. The crew of each station consisted of a midshipman and five or six seamen, and messages were transmitted somewhat in the same way as by the naval semaphore system of the present day. Under favourable conditions a message could be sent from Yarmouth to the Nore in five minutes. Another great defensive work was the Royal Military Canal and Road. Dymchurch wall, the bank which keeps the sea out of Romney Marsh, affords a very favourable landing place for troops disembarking in small boats from transports and so was looked upon as a very likely landing place for the French. The canal and road, 23 miles long, were constructed between 1805 and 1812. They were designed as a retrenchment to this dangerous part of the coast, the canal being an obstacle while the road provided a covered route for the movement of troops to any threatened point. The canal is laid out in straight lengths with gun positions at the angles to flank it.

Only a brief outline can be given of the early defences of Chatham. The Dockyard was started in the reign of Henry VIII. and then occupied a small area near the Chatham Parish Church. In the museum in the Dockyard is a plan showing the additions made in each subsequent reign. The last great extension was made in 1875 when the whole of St. Mary's Island was taken in. The three main basins lie along what was formerly St. Mary's Creek. Upnor Castle was built by Queen Elizabeth to guard the approach to the Dockyard by river, and another fort was constructed just below Cockham Wood. Later it was found that small boats could come up St. Mary's Creek without coming under the fire of either of these and a blockhouse at Gillingham was added. When in 1667 the Dutch fleet came up the Medway a chain was stretched across the river from Cockham Wood Fort to Gillingham Fort to bar their progress, but it was disconnected by the Dutch and some of their ships got up as high as the Gunwharf. Outside the gate of the Naval Barracks at Chatham and also outside the museum in the Dockyard are some old guns with a varied history. They bear the Tudor royal arms so presumably they were originally English, but they were found on a Dutch man-of-war, the *Mathias*, when captured in 1653. When the Dutch came up the Medway the *Mathias* was one of the ships moored across the river to obstruct the passage. She was however burnt and sunk and the guns lay at the bottom of the river until fished up in 1876. The Dockyard was first enclosed by a wall in 1634, but its land defences were not seriously considered until 1709 when land was bought outside. The first defences appear to have been constructed between 1725 and 1730. The "Lines" were first constructed in 1756 and consisted then merely of an earth parapet

Digitized by Google

5 ft. thick. The works much as we know them now, took their present form between 1778 and 1780. When completed in 1780 they mounted 60 guns and required a garrison of 7,000 men. The princes who gave the names to the various bastions were brothers of George III.; the other names, Cornwallis, Amhurst, Townshend, etc., commemorate distinguished Masters-General of the Ordnance. Fort Pitt apparently takes its name from Lieut.-General Pitt who commanded the garrison in 1783.

Chatham Barracks were completed in 1778 and were no doubt intended partly to house the Militia so often encamped at or near Chatham about this time, and then to be occupied by Regulars returning from America. Brompton Barracks were built in 1804, St. Mary's in 1807. Fort Clarence, and the Clarence and Medway Towers still remain; Delce Tower has recently been sold by the War Department; Gibraltar Tower has long ago disappeared; it stood near the north-east corner of what is now the Victoria Gardens.

Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(*Continued*).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

May 31st (contd.). Thomar was reached next night, where they were billeted on a very good house; and Abrantes the following day, June 10th:—"Where I found Col. Fletcher, Boothby, Burgoyne, etc." Here he remained till the 25th, losing his baggage horse, which had to be shot.

ABRANTES, *June 17th*, 1809.

MY DEAR FATHER,

I wrote to you from Oporto, upon our return to that place; since that time nothing material has occurred. We marched from Oporto to Coimbra and from thence to this town, in the neighbourhood of which all the army are now hutted or encamped, and where Sir A. Wellesley is with Head Qrs. All our officers are now here with Col. Fletcher, making plans, etc. . . .

I understand that Capt. Buchanan is Adjutant vice Jones resigned, notwithstanding what I was promised on that subject; it however gives me little concern, as I had not placed much confidence in it, and indeed am not very anxious about it; yet I think Handfield should let you or me know something more about the affair, for you know his promises were very decided, even in the name of the General. I am certainly very unfortunate in these things. I have had the misfortune to lose my baggage horse for which I gave 90 dollars, when we marched from Lisbon; he died a day or two ago; he was a good deal knocked up during the marches and at last died. If he had been killed or glandered I should have been allowed £18 for him, but as it now happens I shall get nothing. I must do as well as I can to get another before we march from here, but the expenses of this kind will ruin me if it goes on. Notwithstanding these untoward circumstances I feel happy and thankful that my health has been restored and continued to me; I hope it will please God to continue that blessing, and I shall then be able to get through this world somehow or other. . . .

This is a large town upon the river Tagus which runs to Lisbon, about 100 miles from here; it is one of the places I was sent to reconnoitre when I first came to this country. It is said that we are to move into Spain shortly; part of the army is advanced towards the frontiers. On the 10th instant the French endeavoured to force the Bridge of Alcantara, a town in Spain about 50 or 60 miles off, upon the river Tagus; our people blew up the bridge by a mine which Lt. Stanway of our Corps had prepared, and which, luckily for him succeeded; soon afterwards they retired, but I do not know where they are.

Digitized by Google

M.-Genl. Tilson whom I was attached to returns to England; he could not agree with Marshal Beresford, and was disgusted at being obliged to serve among the Portuguese troops. Capt. Chapman continues at Lisbon still; they are fortifying it upon a large scale; this also is to be fortified, Capt. Patton has been here some time for that purpose.

I hope you will let me know whatever news you have, particularly what B.-Major Handfield says; I really think he has not been long enough in office to entitle him to forget every promise he makes; however you may remember me to him when you see him. You should get a map of Spain and Portugal in order to trace our movements; for if we go into Spain I daresay we shall not be idle. I shall have to resume the study of Spanish, I have my grammar, etc., with me. I get on tolerably well with Portuguese, at least I can make them understand almost anything I wish, yet I have not studied much, thinking we shall soon have occasion for Spanish. In fact I neither like Portuguese nor Portugal, although the country and climate is fine. . . .

On the 29th of May I was 21 years of age; I did not fail to send you all my best wishes, which is the only thing a poor soldier could do (upon a march) when he became of age. Whenever you write give my best love to my dear mother and all my dear brothers and sisters. . . . Tell my dear mother I would write to her as well as you, was I not fearful of the expense of postage; she may be assured I do not want in inclination. I remain, etc., etc.,

RICE JONES.

Capt. Burgoyne and another officer having been sent off to reconnoitre the northern frontier of Portugal,—"Lt.-Col. Fletcher wished me to reconnoitre the river Zezere, but I was unable to do so for want of horses."

June 25th. "The Col. having desired me to proceed to reconnoitre some rivers in Spain," a start was made, in company with Col. Delancy and Lt. D., of the Portuguese Engineers. Passing through Castello-Branco and Salvaterra, they entered Spain, for the first time, paying a visit to Sir R. Wilson and the Lusitanian Legion. Next day, June 29th, "Rode to Alcantara with Lt. Stanway to see the bridge he has destroyed; the second arch from the right bank is blown up, and not a stone of the arch is standing. The arch which is destroyed was blown up and re-built by Charles V., of Spain."

This magnificent bridge—one of the finest specimens of Roman work in the Peninsula, if not in the world, was built across the Tagus, A.D. 105, by the Emperor Trajan. The material is granite, laid in large blocks; no mortar being used in its construction. Its length is 616 ft. with a width of 20 ft. The two middle piers are of a height of 190 ft.; the arch having a span of 150 ft. In the centre of the bridge is a Triumphal Arch bearing a Latin inscription. In the Journals of General Sir A. Dickson, Royal Artillery (edited by Major J. Leslie, R.A.), we learn that the bridge was broken by order of Colonel Mayne, of the Lusitanian Legion; that the Spaniards were very angry, as it was subsequently ascertained that only a small

Digitized by Google

body of cavalry were approaching; they said the bridge had been preserved by the Goths, Moors, and other barbarous nations, and at last destroyed by the Portuguese—the most barbarous of all. As a matter of fact, this piece of vandalism was performed by an Englishman, Lieut. Stanway, of the Engineers, by superior orders.

Placencia, July 2nd. "This morning I received a message from the Junta, saying they wished to see me; upon my going there with Capt. Whittingham (who is a Brigadier-General in the Spanish Service), they requested me to fix upon a spot the most proper for a bridge over the river Teitar; this I promised to do, and they gave me an order for the different villages near to do whatever I required for the service." Proceeding on his mission, our author found himself billeted one night "upon the house of a very well-disposed peasant"; the next "on the house of a cross old widow woman." Reaching Soto Serrano, very late, the night following, "we had to awaken the Alcadi who afterwards had to awaken his Secretario, and after holding a council with him he endeavoured to waken the people of several houses, but for some time in vain; at last we were received into a house, got some supper and then repaired to a clean, good bed."

On the return journey, he passed through Villar, "found here some Spanish troops; the officers were civil and I got good accommodation." Next day he regained Placencia, where he was joined by Colonel Fletcher, and remained there till July 15th, drawing up a report of his late proceedings. On the latter date, he set off, in accordance with orders, to reconnoitre the river Teitar. At Losar he found Sir R. Wilson, with whom he took up his quarters, "and during all the time lived at his table." Next day, July 18th, he accompanied Sir R. Wilson and his cavalry to Arenas, where a visit was paid to the fine palace of the Infant Don Luis which had been given to Godoy,—"and we got the acclamations of the populace."

"Next day Sir R. Wilson and myself rode to the Bridge of Teitar, and returned; he posted his troops in their position."

PLASENCIA, *July* 11, 1809.

MY DEAR FATHER, . . . On the 27th ult. the army marched from Abrantes and arrived here on the 8th instant. Sir Arthur is gone to the Spanish Army under Genl. Cuesta who are on the Tagus at Puente del Arzobispo and we are now halting until his return; the advance has this instant been ordered to march and it is supposed we shall all follow to-morrow morning. The French Army under Victor are at Talavera Veija about four or five days march from us, but is uncertain where or whether they will wait for us at all. I was sent forward from Abrantes on the 26th to reconnoitre the country about the rivers Alagon (which we have already crossed) and the Tietar which we shall cross about 15 miles from hence. When I arrived here I found the French had left this place just a week; their outposts had never entered this city although they had been in sight of it some time. They have as usual burnt and destroyed all the bridges, towns, etc., on their retreat.

Digitized by Google

During the whole of the march the army have been encamped in huts, so that I was fortunate in being sent alone in front, as I always got in the best quarters, being the only British officer they had then seen. I am considered as attached to the 4th Division of the army, but I have not yet joined them and we expect a new arrangement when B.-Genl. Craufurd with the light troops from England come up; they are barely two or three days march behind. . . . The Colonel has made me an offer of the Adjutancy when vacant which I told him I should accept with pleasure. . . . In the meantime he desired me to be with Mulcaster in order to see his method of carrying on the service. This will give me three shillings a day more pay, and is most probably a more permanent situation than most other Adjutants; besides which I shall be with the Col. at Hd. Qrs. of the army always.

I have bought another horse for 60 dollars, but it is a poor-looking beast; however he will do very well to carry my servant and baggage. My large horse is very much out of condition and has rather a sore back; I mean to give him all the rest possible until the time when we are likely to have an action, and then I shall mount him. How does my old friend Hollyhock go on? he would be invaluable in this country; you cannot imagine the superiority of the English horses; I will certainly never leave England again without one. You know very well that on service the greatest cares and troubles of mounted officers are their horses. . . . I hope you will continue to send me all the news you can; nothing gives one so much pleasure as receiving a letter from you. . . . My love waits on my dear mother, my dear brothers and sisters. . . .

RICE JONES.

Great events were impending. The British Army was advancing, and a few days later would be engaged with the enemy at Talavera. Napier, in his history of the war, tells us that "Wilson, ascending the right bank of the Teitar, gained the pass of Arenas and the pass of San Pedro Bernado in which position, having 4,000 troops, he covered the rich Vera de Plascencia and menaced Victor's communication with the King."

To continue the diary :—"*July 20th.* At 4 o'clock this morning I set off from Arenas with my servant and a guide, until we arrived a short distance from Parillas, where we were informed that a party of 40 French Dragoons had just entered that village which they were then plundering; we therefore turned to the right towards Naval Carno which place we were also prevented entering by hearing that 13 of the enemy's cavalry had just arrived there. Presently we found some German Dragoons, and proceeded quietly to Oropesa. Upon my arrival I saw Sir A. Wellesley and delivered him some messages from Sir R. Wilson. I was soon ordered to be in readiness to return to Sir R. Wilson to-night."

This very day the British Army had reached Oropesa, having crossed the Teitar two days previously;—"An English officer of the Staff-corps,"—says Napier, "having taken the materials of an old house,

Digitized by Google

felled some pine trees three miles off, and in one day thrown a solid bridge over that river."

July 21st. "At 11 o'clock last night I set out with my servant and a guide, and having an order to take a Spanish escort of cavalry with me from—(?), I left my horse there to return with my servant to the army, and mounted on a Spanish Dragoon horse, and accompanied by one Dragoon I rode to Naval Carno where I procured another horse, an escort of 19 men and a guide, and proceeded towards Buenventura hoping to find Sir R. Wilson there. At Hontares near the Puento de Teitar, a party of French Dragoons commenced firing upon us which we were unable to return for want of ammunition, but upon our proceeding to charge they retired up the hills, on the other side of which they were supported by a patrole of cavalry; we therefore thought it prudent to give up the pursuit of them, and continued on the bank of the Teitar to Buenventura; at this place I left the corporal and eight of the men, their horses being unable to proceed, and with the remaining ten men I followed Sir R. Wilson who had left that place in the morning. Soon after leaving the town I learnt that the enemy were in Navalmorguerde, and I therefore sent orders for the party at Buenventura to continue their route after Sir R. Wilson's troops, as far as they were able. I overtook Sir R. Wilson on his march, and he soon after took a direction towards the Teitar on the banks of which he encamped, near Ladrada. I dined with him, and slept there."

July 22. Left Ladrada at daylight, at a distance of 2 leagues found the corporal and his party of Spanish cavalry, halted and got a cup of chocolate, and taking with me 10 Dragoons ascended a steep hill to Navalmorguarde, where we were received with the greatest enthusiasm. Hearing that firing had been heard all the morning in the direction of Gamonal, I made the best of my way towards that town, avoiding the villages occupied by the enemy, and rode as fast as I could towards Talavera, which the British and Spaniards were then entering. I had the greatest difficulty before I could pass the Spanish column, but at length joined the army once more. I procured a billet, but altho' I walked about to find my servant and horses until dark I was obliged to retire to rest without either.

Talavera, Sunday, July 23rd. At dawn of day I walked over the British camp, but was some hours before I could find my servant, etc. I immediately mounted my horse, in order to find Col. Fletcher who has appointed me his Adjutant. I joined the column in advance expecting that he would soon arrive there, but hearing that he was with Sir A. Wellesley near the bridge over the Alberche, I proceeded there where I found him at a conference between Sir Arthur and Cuesta; reconnoitred the banks of the river with the Col., and was just beginning to act with Lord Macduff, Wittingham, etc., when Sir Arthur mounted and I was obliged to follow him; he rode towards the army and ordered them to return to the ground they had

Digitized by Google

occupied during the night, the intended attack being postponed until next day.

Monday, July 24. "At 2 o'clock this morning part of the line began their march towards the River, where they arrived about half past 4 o'clock, and were surprised to find that the enemy had left their position—(the Left of which was on the Tagus, their Right on Casalegas, and their Front was hid by the river Alberche) during the night. I remained at the Convent until Genl. Hill's Division arrived, being ordered to Maj.-Genl. Tilson's for the day. Finding the French had retreated I crossed the river and proceeded through the French camp towards Casalegas, and returned by the bridge of the Alberche to Talavera. The Spanish Army began a pursuit of the French, whilst our advance halted near Casalegas, and the rest of our army returned to the neighbourhood of the town."

TALAVERA DE LA REYNA, *July* 24, 1809.

MY DEAR FATHER,

Since my last letter which was from Plasencia, the army has moved to this place; on the 17th inst. we marched from Plasencia; on the 22nd our advance fell in with that of the French at Gamonal, a town 2 leagues from this; they were driven out of that town and also from this; their main body continued posted on the other side of the Alberche a river which runs into the Tagus about 4 miles from this place. The next morning our troops moved towards the river intending to cross it by a ford near the right of the French, whilst the Spanish Army under General Cuesta was to cross it over a bridge on the left of the enemy. Sir Arthur however thought it prudent to put off the attack until the next morning, particularly (it is said) by desire of General Cuesta; accordingly our army as well as that of the Spaniards was put in motion this morning about 2 o'clock with the intention of forcing the passage of the river at daybreak; this would I daresay have cost us a great number of men, and I much doubt if the Spaniards would have been able to force the bridge as the enemy has had so much time to prepare us a warm reception. Upon reaching the bank of the river we were not a little surprised to find that they had all left their position the day before, and their camp on the other side deserted; we found that they had retreated during the night or early this morning. Our troops are ordered to halt here till to-morrow, which appears to be a good arrangement, as we should only fatigue our troops by an useless pursuit. The Spanish Army are in full march after them: they are very numerous but we do not think they will fight well, but it is impossible to say; they certainly ought to behave well in this country. The French Army are calculated at 18 or 20,000 men; they have another under Sebastian near Toledo of about 17,000 men; it is thought therefore that they mean to unite their force before they give us battle.

During the march from Plasencia to this town I was again sent forward to reconnoitre; I went up the river Teitar and along the right flank of the French to Arenas; I went with a column of Portuguese and Spaniards under Sir. R. Wilson who as usual behaved extremely kind to me. From Arenas I (with my servant only) crossed the French patrols and videts

Digitized by Google

and rejoined the British Army at Oropesa; there I found Sir Arthur and informed him that Sir R. Wilson was on the right of the enemy; Sir Arthur then desired me to return to Sir Robt. Wilson that night and gave me an escort of Spanish dragoons with which I found Sir R. and returned to the army at Gamonal. I have had several providential escapes of being taken prisoner—was obliged to go across the country, avoiding the roads, etc. I am greatly indebted to the peasants of the country who always informed me when the enemy's patrols were near, as well as the best way of avoiding them.

Our promotion is come out and I am now living with Colonel Fletcher as his Adjutant which I hope I shall continue to do for some time. I am extremely well in health and spirits and hope you all continue so. . .

R. JONES.

Tuesday passed off in quiet; two of the Engineer officers being ordered to reconnoitre the Tagus and the Alberche, respectively.

Wednesday, July 26, also passed off quietly :—"Rode this day to Casalegas and ordered the entrenching tools from the German Brigade to the Guards. The Spaniards returned to the bridge over the Alberche this evening, the French having turned upon them. The town began to be crowded with the Spanish fugitives."

Thursday, July 27. "At daybreak rode along our camp to find the entrenching tools under charge of Corpl. Black; at last I discovered him near the entrance of the town. I then followed Colonel Fletcher who had gone with Sir Arthur to see General Cuesta at the bridge of the Alberche; on the way I overtook Foster; after waiting a short time on the other side of the river they all returned, as did Foster and myself. As soon as we were all in the town, the Col. informed us that at 11 o'clock we were to begin constructing a Redoubt for ten guns which is to be on rising ground forming the centre of the position to be occupied by the British and Spanish troops in the event of an attack being made by the enemy. We immediately began to lay it out, and a party of 200 men from Colonel ——'s Brigade were set to work; this party was relieved at 3 o'clock by one of the same strength from Brigadier-Genl. Campbell's, soon after which the firing, which we had heard for some time towards Casalegas, became nearer and our troops began to take up their ground in the position. At 6 o'clock this line was completed and ready, whilst a cannonade continued advancing rapidly towards our centre from the Convent near the Alberche. At 7 o'clock the enemy were close to our line, and the working-party took to their arms; another party at this moment arrived to relieve the former, but were, by Sir Arthur ordered to return to their regiments. The Spaniards whose left were in the redoubt at the same time commenced a brisk fire, but without anything opposed to them at which it could be directed. After waiting to collect the tools which were scattered about, I joined Col. Fletcher, and we proceeded towards our left where a heavy and running fire had just commenced; this soon after

Digitized by Google

ceased and we found Maj.-Genl. Hill's Division in quiet possession of the little hill which formed our left. The remainder of the night we rode amongst our line, but were not able to find Sir Arthur; at length we lay down under a tree to sleep, but were roused in a quarter of an hour by firing again which continued at intervals until daylight.

Friday, 28th July. At dawn this morning Col. Fletcher and myself found Sir Arthur on the hill which formed the left of our position, and the enemy's line (having several batteries along their front) drawn up opposite our left and centre. About 5 o'clock a heavy cannonade commenced by signal from the enemy and which was soon answered by our artillery; this was immediately succeeded by an attack upon the high ground upon our left and which was obstinately contested. During this time I was ordered by Col. Bathurst to find the cavalry and direct them to proceed up a valley which lay between the small hill we had occupied and a range of rocky heights. I first met the Duke D'Albuquerque to whom I communicated this order, and shortly after saw Genl. Fane moving up with the Heavy Dragoons; after this I returned to Sir Arthur through a heavy fire and found the enemy had been repulsed. The cannonade continued until the middle of the day when a short lull took place whilst the enemy might easily be seen cooking at a distance in the rear. Soon after, a general attack upon our whole line commenced; this was first repulsed by Brigadier-Genl. A. Campbell's Brigade on the right, and 19 cannon and some standards, etc., taken was the result of his charges. At the same time the centre under Lt.-Genl. Sherbrooke came to the bayonet and drove the enemy a considerable distance, but were obliged to retire rather precipitately, their left flank being totally exposed to the fire of the French Batteries which at that time nearly enfiladed the whole of our centre line; this was ably supported by the 1st Battalion, 48th Regiment, which had been ordered by Sir Arthur to cover their retreat, and which Regiment formed and kept possession of our ground until the guards rallied, when, coming once more to the charge, the French retired in every direction. During this time the enemy repeated their attempt on the hill on our left by moving three heavy columns along the valley to the north; this movement was rendered useless by the very gallant charge of the 23rd Light Dragoons which Regiment suffered extremely, but the enemy were prevented deploying from the close column they had formed in, the remainder of the day. The Heavy Dragoons continued in line directly in front of these columns and effectually kept them in check. After having thus defeated this general attack we remained tolerably quiet until dark, when the Col. and myself dismounted in a vineyard, between the bivouac of Sir Arthur and our line. We were fortunate enough to procure a little biscuit and wine from the Commissary who had brought a little for headquarters and had a good night's sleep.

Digitized by Google

Saturday, July 29th. At daybreak this morning the Col. and myself were upon the hill on our left, and waited anxiously for sunrise to ascertain where the enemy were; in a short time we had the pleasure of seeing they had all quitted the field during the night, and had thus given us complete possession of the Field of Battle. We immediately rode to Sir Arthur, and Col. Fletcher communicated this information to him, at which he seemed pleased, and sent us into Talavera to desire Capt. Canning, his A.D.C., to inform General Cuesta; after meeting him we returned to the hill and from thence rode along our line to the town of Talavera; on our way we met Mulcaster who had just arrived from reconnoitring the Tagus. We found Goldfinch and Forster were both well, and that Stanway was slightly wounded in the belly. We went to the Col.'s Quarters at Talavera and found poor Boothby with his leg badly wounded ever since the night of the 27th July; I went directly for Fitzpatrick, Surgeon to the Ordnance, and luckily found him; he said that amputation was the only chance of saving his life, and very soon after he performed the operation about 2½ in. above the knee; from that time Boothby gradually got better. I sent in a return of killed and wounded, and then went with Lt. Forster to sketch the Field of Battle.

July 30th. Rode with Forster the other side of the Tagus and sketched its course as well as that of the Alberche; the enemy's posts upon that river still. Next morning rode with Capt. Chapman over the Battle Field.

August 2nd, the army ordered to march to-morrow morning; great uncertainty which road we shall take.

TALAVERA, *July* 29, 1809.

MY DEAR FATHER,

Through divine mercy I have once more to let you know that I am very well in health and have been preserved unhurt in one of the most dreadful battles that has lately been fought; and our loss has been extremely great, as has been that of the enemy; the newspapers will give you the Gazette account of the affair. A private soldier of the 71st Regiment, in describing the earlier battles of the war, gives a vivid picture of the characteristic traits of the opposing troops:—"They (the French) came upon us crying and shouting, to the very points of our bayonets. Our awful silence and determined advance they could not stand; they put about and fled." And again;—"How different the duty of the French officers from ours! They, stimulating the men by their example; the men vociferating, each chaffing each until they appear in a fury. After the first huzza, the British officers restraining their men, still as death—'Steady, lads, steady!' is all you hear, and that in an undertone." And on another occasion—"Down they came shouting, as usual; we kept them at bay, in spite of their cries and formidable looks. How different their appearance from ours! their hats set round with feathers, their beards long and black gave them a fierce look; their stature was superior to ours; most of us were young; we looked like boys; they like savages.

Digitized by Google

But we had the true spirit in us; we foiled them in every attempt." The French have now retired beyond the river Alberche to their old position, but whether they mean to remain there, retreat, or attack us again, it is impossible to say. Fortunately for us the Light Brigade have just arrived and will make up for the numbers we lost yesterday. We are very much in want of provisions, which I believe prevented our moving forward some days ago. I would send you a longer letter, but it is with difficulty I can get *this Note* taken by the officer who takes the Dispatches. Capt. Boothby was wounded by a musquet ball in the calf of his leg and has been obliged to suffer amputation. Lt. Stanway was struck by a ball which spent itself in passing thro' his horse. . . . I was with the Colonel near Sir Arthur during the whole time, and of course had a great number of narrow escapes for which I desire to return thanks to God. . . .

RICE JONES.

Indirect evidence of the privations of the army during these operations is afforded by Lord Wellington's General Orders: thus, under date, Talavera de-la-Reyna, August 2, 1809, he writes, "The soldiers plunder the inhabitants bringing in provisions, notwithstanding the repeated orders upon this subject, and the knowledge which they all have, that this practice must tend to their own distress." And again, on the 9th of August—"The soldiers themselves render the difficulties of the moment greater than they would otherwise be by their irregularity, as they seize and plunder the mules coming in with provisions, by which the good and regular soldiers of the army are deprived of their just share."

August 3rd. The army marched this morning from Talavera back to Oropesa, in order to attack the force which was coming upon our rear from Plascencia, under Marshal Soult. We were quartered in a Nunnery. Whilst at dinner in the evening, Goldfinch informed us that a Council of War was then sitting and that it was reported the enemy were within a League of us and that probably we should be attacked before daylight; we made the necessary preparations and then went to sleep.

August 4th. The army were out at daylight this morning; soon after, General Cuesta and the Spanish troops came pouring in upon us, having quitted Talavera and deserted our sick; it was soon understood that we should be obliged to cross the Tagus at Puente del Arzobispo, and accordingly our baggage and sick began moving there at day-break. At half past 7 o'clock we marched from Oropesa, halted at Puenta de Arzobispo and got something to eat; we then slept in a wood which our army occupied, about a mile from the bridge.

August 5th. At 7 o'clock the army marched and halted in advance of this place (Paralidas) which was Hd. Qrs. Col. Fletcher, Chapman and myself were billeted upon a small cottage; we were very short of provisions. Next morning the army marched at 7 as usual, halted at Mesa del Ibor; the Light Brigade advanced

Digitized by Google

towards Almaraz. *August 7th.* "Began our march as usual with Hd. Qrs.: very soon returned, procured a guide with whom we went to the Bridge of Almaraz where we found a Spanish post on this side of the Tagus and a French one on the opposite. The Col. fixed upon the sites of some batteries to defend the passage of the river; during our operations we were a little disturbed by the fire of the enemy. From thence we went to Roman Gordo which was the quarters of the Light Brigade, and on to Deleytosa where we found Hd. Qrs. established. Next day Capt. Chapman was sent to the Bridge of Almaraz to construct the batteries."

August 11th. The army marched from Deleytosa; Hd. Qrs. were fixed for the night at Jaraicejo,—"the town is entirely deserted and mostly in ruins." Next morning, "the Col. and myself pitched a marquee, it being impossible from the number of fleas, and the quantity of dirt to sleep in the village; very much in want of provisions." *August 13th.* "Rode with the Col. to Las Casas del Puerto to see Genl. Craufurd who occupies that place and the neighbouring passes. From the Puente de Almaraz we had a fine view over the country between the Tagus and Teitar, and we thought we perceived the dust of a French Column north of the latter river.

August 15th. Accompanied the Col. to the town (Truxillo); the place being quite full of Spanish troops we with difficulty obtained admittance into a Quarters: we were obliged to remain in a cobbler's shop, where however we enjoyed the luxury of a good sleep upon *Matto*, and also some tolerable bread and wine for supper;—N.B. The first wine we tasted from Talavera. *August 16th.* Searched the Castle and town of Truxillo, along with Col. Fletcher and a Priest, to find timber of a sufficient length to repair some of the bridges over the Tagus. Our search proved ineffectual; I was therefore desired by the Col. to proceed to Caceres whilst he returned to Hd. Qrs. and reported the result of our search. Accordingly I left Truxillo with a Spanish Lt.-Col. who was acquainted with the resources of the town."

Our author remained three days at Caceres, which contained about 3,000 inhabitants, and had never been plundered by the French. His mission proving fruitless, he rejoined the army on August 20th:—"Upon my arrival I met the Col. and Chapman endeavouring to make good their billet upon a house which, as well as the rest of the town (Truxillo) was full of Spanish officers; in order to effect this we were obliged to have recourse to the Junta, etc., but at last succeeded in getting miserable accommodations." While here he visited the remains of the tomb of Pizarro, etc., "it has been defaced and the church nearly destroyed by the French."

"It was this gloomy city, situated on a black eminence," wrote W. Beckford, "that gave birth to the ruthless Pizarro, the scourge of the Peruvians, and the murderer of Atabaliba: the nakedest and most dreary region I ever beheld."

Digitized by Google

August 23. "Halted at Medellin, where grapes were obtained for the first time; in the evening I rode with the Col. over the field of battle between the French under Marshal Victor and the Spanish under Cuesta when the latter was completely routed. The enemy appear to have received the attack of the Spaniards in a perfect plain; their left being upon the river, and their right a little east of the town. We afterwards visited the fine old castle." Thence on to Merida on August 24th, where a halt was made till the end of the month;—"the army was hutted in the environs; the weather was intensely hot; the evenings we generally spent in riding about the neighbourhood which abounds in Roman antiquities, particularly the remains of an aqueduct, of Temples of Diana and Mars, and an Amphitheatre and a Triumphal Arch (still perfect)."

September 2nd. The army marched for Badajoz which was reached next day. "Here the Col., Chapman, and myself were billeted upon a Dignitary of the Church and remained idle for some time."

TRUXILLO, *August* 25, 1809.

MY DEAR FATHER,

My last letter was from Talavera the day after the Battle; in it I had only time to let you know of my welfare and since then no opportunity has occurred of writing to you. You are no doubt before this time in possession of full details of the glorious although fatal results of those days; and I have only to express my gratitude to God who so wonderfully preserved me during the dreadful slaughter that took place and was I believe never exceeded amongst so small a number of men. Our total number, according to returns that day did not exceed 20,000 men, whilst the enemy had, according to their own accounts 45,000, but it is generally thought they had more in the field. We lost about 5,000 altogether, and the French not less than 10 or 11,000. . . . From Jaraycejo, where we halted ten days, we moved yesterday to this town. For some days before the Battle of Talavera provisions became very scarce, and for some days we were all without anything except what accident threw in our way; we have never tasted wine or anything of that kind until we came here; the roads were very bad and the weather extremely warm. I am however very happy to find that we have at last begun to retreat in earnest. It is understood that we are to take a position for the present upon the frontiers of Portugal; we can at present do just as we please as I fancy the French have no idea of attacking us, and we cannot possibly attack them, our cavalry being completely done up, and nearly half our men either sick or wounded. Sickness is daily increasing, and I have little doubt we shall soon see England. No good I am convinced can ever be done for these people. . . .

RICE JONES.

(*To be continued*).

Digitized by Google

MEMOIR.

LIEUT.-GEN. SIR GORDON DOUGLAS PRITCHARD, K.C.B., COLONEL COMMANDANT, R.E.

GORDON DOUGLAS PRITCHARD was the seventh son of William Waugh Pritchard, Esq., Proctor at Doctor's Commons, and was born on April 22nd, 1835. He was educated at the King's College, London, and obtained his commission in the Royal Engineers in 1855, passing out of Woolwich at the head of his batch.

After the usual course at the S.M.E., he was posted to the 23rd Company and embarked with it for China on the 23rd of April, 1857. The voyage was a long one—round the Cape of Good Hope—and it was three months before *The Captain* (a small sailing ship) touched at Singapore, the first point of call.

The Indian Mutiny had meanwhile broken out and Lord Elgin (the Plenipotentiary) ordered the 23rd Company on its arrival to be landed and at once re-embarked for India on H.M.S. *Sansparíel.* Leaving Singapore on September 1st, it arrived at Calcutta on the 18th, being amongst the first troops to land in India after the Mutiny had commenced.

The first action in which Pritchard took part was at Khujiva, when the Company had its captain and five men wounded. He also took part in the Relief of Lucknow, under Lord Clyde, and was present at the storming of the Secundra Bagh—where 2,000 of the rebels were slain and the British loss was 400 men. He was with the force which escorted the Lucknow garrison to Cawnpore, which the Gwalior contingent had captured, and was at the Battle of Cawnpore on the 6th of December, 1857. He was also at the action of Khodagunge and at the subsequent Siege and Capture of Lucknow. Other actions he took part in were:—The attack on Fort Roya; the action of Aleygung, the capture of Bareilly; the captures of Doundettera and of Fort Oomreah, the action of Burjidia; the capture of Fort

Digitized by Google

Musjidia and the affair on the river Raptee when the Nana Sahib escaped into Nepaul. For these services he received the Mutiny medal and two clasps.

Pritchard remained in India with the 23rd Company till the end of 1859 and then went with it to Hong Kong, where it formed part of the Expeditionary Force under General Sir Hope Grant. After wintering at Canton it proceeded north to Talienwan Bay in the spring of 1860. The main army was encamped here in two divisions, one under Major-General Sir John Michel and the other under Major-General Sir R. Napier. On his arrival at Talienwan, Pritchard was ordered to join Sir John Michel's Division and to take over the command of the 10th Company, relieving Lieut.-Colonel Fisher, R.E. He was with this division at the capture of Pehtang and the occupation of Sinho and Tangku.

The 2nd Division under Sir Robert Napier had meanwhile besieged the North Taku Fort, and Pritchard was now ordered to join this division and report himself to Major (afterwards Sir G.) Graham, who had orders to lead the assault using the British portable bridges.

When however it took place it was found to be impossible to use the bridges, and the passage of the ditches was ultimately effected by ladders. The desperate nature of the fighting can be best realized by the fact that no less than 7 V.C.'s were gained during the assault.

The attack on the fort is described as follows in Sir R. Napier's despatch :—"The English pontoon bridge, carried by a party of Marines, advancing on the line of the causeway, opposite the centre of the fort, was met by so heavy a fire that half the carriers were immediately disabled and the construction of the bridge rendered impracticable. Lieut.-Colonel Travers, R.M.L.I., and Major Graham, R.E., were also wounded in attempting to carry out this duty. I therefore directed ladders to be brought forward and passed across the ditches towards the right. This was carried out by Lieut. Pritchard, R.E., and parties of our infantry, effecting a passage of the ditches some by means of the ladders and others by swimming made their way to the gate."

In the list of officers mentioned at the end of the despatch, Lieut. Pritchard is referred to for "gallant conduct in taking up ladders, and bridging the ditch under heavy fire." He was present at the affairs of the 18th and 23rd of September and also at the taking of Pekin, being twice mentioned in despatches and receiving the medal with two clasps and the brevet of major.

At the end of the campaign Pritchard was relieved at Tientsin by Major Charles Gordon, and on arrival home was quartered at Colchester under Capt. (afterwards Sir Andrew) Clarke.

Digitized by Google

After a course of musketry at Hythe, where he obtained a special certificate, he was successively quartered at Aldershot, Portsmouth and Chatham.

In 1867 he applied to Sir Robert Napier to be allowed to join the Abyssinian Expedition, and he served through the whole campaign in command of the 10th Company. He led the assault at the storming of Magdala and was wounded in the right shoulder and arm, being ultimately mentioned in despatches and given a brevet of Lieutenant-Colonel in 1868.

He returned to Dover with his company and remained there two years, when he exchanged with Major Thackeray, V.C., for a tour of service in India. On arrival there he was posted to the Irrigation Department, and in 1872 relieved Capt. Helsham-Jones as Executive Engineer of the Agra Canal, which was then under construction. This canal, which joined the Ganges near Delhi to the Jumna at Agra, covered an enormous tract of hitherto barren land. It was completed in 1874 and its success has been since proved by the great tract of land it has made fertile.

In 1876 Pritchard was made Colonel, and he returned to England in 1881 after an absence of 11 years in India. In 1882 he was appointed C.R.E. at the Curragh, which appointment he held until 1886, when he was made a Major-General and created a Companion of the Bath. He became a Lieutenant-General in 1890, retiring a year later in 1891.

General Pritchard became a member of the R.E. Charitable Fund in 1890, and at the time of his death had been its Honorary Secretary for over 18 years. The untiring devotion with which he carried out his duties as Secretary is best judged by the reference made to him by Colonel L. Jackson at the last Annual Corps Meeting. "We all know," he said, "the extraordinary amount of work he did in connection with the Charitable Fund. He was a member of the Councils of at least four other charitable institutions, but the Royal Engineers Charitable Fund was particularly the thing that was nearest his heart, and he continued his labours long after failing health might have caused him to give them up. He gave us 18 years of devoted service to this work, and continued it to the last. I feel it will be impossible to replace him."

Sir Gordon Pritchard was also Vice-Chairman of the Committee of the Royal Soldiers' Daughters' Home; member of the Committee of the Royal Free Hospital, Grays Inn Road; member of the Committee of the Royal Cambridge Asylum for Soldiers' Widows and Chairman of its Finance Committee; and member of the Committee of the National Memorial Gordon Boys' Home.

Through being a member of the first three named Committees he

Digitized by Google

was in a position to help any R.E. cases that were up for consideration at the meetings, and he never missed an opportunity of attending —even at great inconvenience to himself.

He married in 1863, Agnes Maria, daughter of W. Hinkes-Cox, Esq., J.P., and had four sons and one daughter.

In 1902 Sir Gordon Pritchard became a Colonel Commandant and in 1906 was promoted in the Order of the Bath and made a K.C.B.

He died at Weybridge on the 23rd of January, 1912.

Digitized by Google

TRANSCRIPT.

REPORT ON ARTIFICIAL ILLUMINANTS, OTHER THAN ELECTRIC, SUITABLE FOR BARRACKS, WORKSHOPS AND LARGE OPEN SPACES.

By Capt. L. N. Malan, R.E.

Introduction.

Good illumination is not necessarily obtained by brilliant lighting, but rather by so arranging and husbanding the sources of light as to obtain the best effects with the minimum waste of power. The choice of a suitable illuminant, the power of each individual source, its siting and proper shading and the colour of the surroundings are therefore all important if a good effect is to be obtained with the least possible cost.

The brightness of the sky has been estimated at 3·5 candle-power per square inch, and it has been recommended that the intrinsic brilliancy of sources of light liable to fall on the direct field of vision should not exceed 5 candle-power per square inch, above which figure the light is found to be harmful to the eye, with the exception of the frosted incandescent electric lamp: flame gas burners, candles and ordinary oil lamps, modern illuminants, exceed this brilliancy to a more or less great extent from the Welsbach gas mantle of 25 candle-power per square inch to the electric arc of 200,000.

It is therefore apparent that to obtain the best results with the minimum of harm, bright sources of light should be kept out of the field of view, or, if visible, their brilliancy ought to be suitably reduced by the effective use of shades.

Such shading has been commonly obtained by the use of frosted or opalescent glass, which, while undoubtedly reducing the brilliance and securing diffusion, does so at the expense of a very large portion of the light absorbed by the shade. In the last few years however the question of scientific shading has been seriously considered, and has resulted in the production of the Holoplane shade. This fitting is designed for all forms of illuminants, and is so arranged that the light is diffused and distributed in a scientific manner, with the minimum absorption of light.

In considering the question of artificial illumination it may not be out of place to borrow from the Holoplane Company their effective motto:

"Light on the object, not in the eye."

A.—A Coal Gas.

1. *General.*—It is not within the scope of this report to enter into an elaborate description of the manufacture of coal gas, as this forms a branch of engineering in itself and many text-books on the subject have

Digitized by Google

been published. It may be said, however, that its distillation from coal, and its purification, require a considerable plant and attention, while storage for the products is required owing to the necessarily intermittent nature of its manufacture.

The yield of gas from one ton of good coal is about 10,000 cubic feet, having an illuminating power of 16 to 17 candles in a burner consuming 5 cubic feet per hour.

2. *Water Gas.*—In practice, coal gas is frequently enriched with "carburetted water gas." Water gas is produced by passing steam through incandescent coke or coal and thus obtaining carbon monoxide. The water gas thus produced is practically non-luminous but burns with an intensely hot flame: it is therefore carburetted or enriched by means of the vapour of crude oil, or cheaper distillate, until a gas is obtained having an illuminating power of about 15 to 20 candles in a 5-ft. jet. Carburetted water gas, containing as it does, about 33 per cent. of carbon monoxide, is highly poisonous and therefore dangerous in the case of leakage. In the mixture of coal gas and carburetted water gas usually employed, this percentage is not more than from about 12 to 15 per cent., and for this reason such a mixture is less dangerous in practice.

3. *Size of Installations.*—It is thus apparent that since the manufacture of coal gas is one of some elaboration it would not be economical to generate it on a smaller scale than would be required for, say about two battalions, and for a small plant of this nature the cost of production would certainly be not less than five or six shillings per 1,000 cubic feet, while in very large plants the cost may not exceed three shillings.

4. *Burners.*—Gas flame burners in common use are of three general types, viz.:—(*a*). Flat flame. (*b*). Argand. (*c*). Regenerative.

(*a*). The flat flame is the least efficient, but is in very common use and may be found in two varieties, viz., the "Batswing" and "Fish-tail." The latter form has a concave tip and two small orifices, while the former with a dome-shaped tip has a slit for the exit of the gas. A good "Batswing" type of burner which is the type in more common use of the two, consuming not less than 4 cubic feet per hour, will give about 2·5 candle-power per cubic foot of 16 candle gas, while a 5-ft. burner will yield from 2·75 to 3 candle-power per foot per hour.

(*b*). The Argand type of burner consists of an annular burner of steatite set within a chimney of glass, and has an efficiency of about 3 to 3·5 candle-power hours per foot with a 16 candle-power burner. This is superior to the flat flame type but with a very rich gas, however, the flat flame burner, particularly the "Fish-tail" pattern, gives better results than one of the Argand type.

(*c*). The Regenerative burner, which is suitable only for very powerful lights of from 100 to 200 candle-power, consists of an inverted burner so contrived that the entering gas and air are heated before their combustion. With gas of about 16 candle-power standard these burners will give from 5 to 7 candle-power per foot per hour. Regenerative burners producing a flame of so high a candle-power throw off considerable heat which renders their continuous use in small rooms undesirable.

Digitized by Google

5. *Modern Improvements in Gas Lighting.*—The introduction in recent years of the incandescent mantle and the employment of high pressures, have so far revolutionized the use of coal gas as to make it a serious competitor with electricity, both in efficiency and in economy. In fact the Corporation of the City of Westminster are now installing coal gas in place of the existing electric light in all the streets within their jurisdiction. For house lighting, moreover, the inconveniences of coal gas have been greatly reduced by devices for controlling the light with the ease usually only associated with electricity.

6. *Mantles.*—The Welsbach or incandescent mantle consists of a fine gauze of the oxides of some rare earths such as thorium. In the first place the mantle is constructed of cotton, it is then impregnated with the metal solution and is ignited; the cotton is burnt away and its form is left composed of metallic oxide. Mantles are heated to incandescence in the flame of the Bunsen burner, either of the ordinary upright or of the inverted type, and have an efficiency of about 20 candle-power per cubic foot per hour. Although mantles have much improved in strength of late years and are specially treated to strengthen them for transport, they are still very brittle once they have been in use, and may be said to have a life of not more than 200 hours on an average.

7. *High-Pressure Gas.*—The use of gas under high pressure has led, more perhaps than even the introduction of the mantle, to the great developments of recent years in the gas industry. The advantages of high-pressure gas are that more intimate mixture of gas and air can be obtained, coupled with a greater velocity of gas as it issues from the burner, and therefore higher flame temperature with more perfect combustion as the result.

The pressures in use at the present day vary from 50 to 55 ins. of water, and are obtained by the employment of a compressor driven by any suitable form of available power. The gas under this pressure is led through the pipes into a chamber in the lamp where it mixes with the requisite amount of air: this mixture then passes through a heater as near the orifice of the burner as possible and thence to the burner when it is consumed under a mantle, the principle being somewhat similar to that of the regenerative burner. An efficiency of 60 candle-power per cubic foot per hour is claimed with ordinary gas of 16-candle standard, while a light of 73·6 candles has actually been obtained in tests. Lamps are constructed in all sizes from 60 to 1,500 candle-power with one or more mantles.

Mantles for use with this system require to be more strongly woven, and are undoubtedly more liable to breakage; for this reason it is advantageous to employ lamps designed for two or three small mantles rather than one large one of the same aggregate power.

In some high-pressure gas systems, air instead of gas is compressed; the advantages claimed are that the ordinary gas pipes can be used for the gas and in the event of anything going wrong with the high-pressure system the light is diminished only and not extinguished. On the other hand the high-pressure air requires a separate system of pipes—an arrangement that is expensive, and not always convenient.

Digitized by Google

8. *Self-Contained Highly Efficient Lamps.*—For use with low-pressure gas supply, or where a high-pressure system is not practicable, attempts have been made to introduce into ordinary gas lamps local pressure-raising or regenerative devices, well-known types being the Lucas Thermopile and the Chipperfield lamps. These lamps are relatively small, are self-contained and can, it is claimed, be used with any pressure and quality of gas off the ordinary supply pipe.

It is moreover claimed that their efficiency is a minimum of 40 candle-power per cubic foot per hour.

9. *Fittings (Low Pressure).*—An excellent gas pendant has been devised at Aldershot for use in barracks, called the "Armee" light. The pendant is similar to the usual type used with an upright incandescent burner, but is so designed that the shade can readily be removed for cleaning purposes without disturbing the light. The fitting is enamelled white and the shades, which are adjustable, are so curved as to throw off the maximum of light. These fittings are only obtainable from Hewlett & Co., 55, High Holborn, London, E.C., at a cost of 11s. 3d. each.

The Bland inverted incandescent burner introduces an improvement in that the mantle is supported by the globe instead of on the burner. When the burner requires cleaning the mantle can be easily removed without damage and replaced, which is not always possible with a fitting of the ordinary type.

10. *Control Devices.*—For domestic or other indoor use two useful contrivances for controlling gas lights from any distant convenient place are the "Norwich" and the "Bland Pneumatic Switch."

In the former system a conveniently situated fitting similar to an electric-light switch checks the passage of gas to the burner and directs its course through a separate passage to the by-pass tube and pilot light. This system requires much extra piping.

The Bland Pneumatic Switch is a fitting entirely separate from the gas system itself and is so arranged that the by-pass on the lamp is actuated by a small pneumatic valve controlled from a distance through a length of fine tubing by the pneumatic switch.

Electric ignition is also in use but not to any great extent.

For the control of lights in high-pressure gas systems "Automatic distance lighters" can be arranged, which enable the lamps to be lighted and extinguished by the increase or decrease of the pressure.

11. *Cost.*—From the above it will be seen that under the best conditions, with gas at 3s. per 1,000 cubic feet, the price of coal gas burnt in a flame burner per 1,000 candle-power hours varies between 1s. 2d. and 5½d. With a mantle, however, the cost of a 1,000 candle-power hours is reduced to about 2d. or 2½d., in addition to the cost of maintenance of the burners, mantles and globes, for which between 2s. and 3s. per annum per burner must be allowed. With high-pressure gas this cost is yet further reduced to 1d. or 1½d. per 1,000 candle-power hours.

9. *Sewer Gas Lamp.*—Mention may here be made of Webb's patent sewer gas extractor and destructor lamp. This lamp, which can be

Digitized by Google

arranged for oil or gas, draws up the foul air and gases from the sewer or other place to be ventilated, and subjects it to a minimum temperature of 600° Fahr., whereby all germs and noxious gases are completely destroyed.

These lamps have been installed successfully in many parts of the world, including India, for sewer ventilation, and are also used to ventilate the mortuaries and post-mortem theatre of the London Hospital.

B.—Petrol Air Gas.

1. *General.*—Although the employment of the lighter of the many hydro-carbon series as an illuminant was started so long ago as 1831, it is only within the last few years that satisfactory methods of employing it have been successfully placed upon the market. Petrol air gas or as it is commonly called "Air Gas" is no new thing scientifically, but having only recently been brought into use on a sound basis it is not as yet widely known nor do any exhaustive treatises on the subject exist. It may not be out of place, therefore, to give in this report a somewhat more detailed description than otherwise might be necessary.

For further information a reference may be made to *Petrol Air Gas*, by Henry O'Connor, published by Messrs. Crosby, Lockwood & Sons.

2. *Nature of Petrol.*—Air gas is a mixture of petrol vapour with air in such proportions as to be non-explosive. Petrol, motor spirit, or carburine is a volatile spirit of petroleum obtained by fractional distillation and consists roughly of 84 per cent. of carbon to 16 per cent. of hydrogen. This spirit consists of a mixture of several hydro-carbons of varying specific gravities and boiling points, and when stored is liable to settle into its component parts in layers of different weights. As any spirit will more freely volatilize when warmed, a rise of temperature will tend to make the lighter hydro-carbons of the petrol volatilize more freely and thus leave a residue of increased specific gravity. For these reasons it is important that the specific gravity of the spirit used should not be too high, as in this case the residue may after a time become too heavy to freely volatilize and thus be useless for making air gas.

The majority of machines now on the market for the manufacture of air gas use a spirit of specific gravity ·680, but one or two in which the spirit is warmed can work with as high a specific gravity as ·720 or even ·760.

3. *Storage of Petrol.*—Petrol has no other than a cleansing effect on metals and may be stored in tanks, barrels or tins, but whatever the method adopted such receptacles except for the necessary small vents must be quite air-tight; and beyond the small quantities required for immediate use, petrol should be kept apart from the engine room, to which it should be led or pumped by suitable piping. Rubber or oil should never be used in connection with petrol as both are dissolved therein.

4. *Filtration.*—Petrol as used in air gas machines and explosion engines must be quite free from water, grit or other foreign matter. Filtration is therefore essential both within the machine, in filling the tanks, and before the gas is passed into the main. For this purpose

Digitized by Google

the petrol or gas is passed through a gauze of 60 meshes to the inch, which, while being large enough to pass liquid petrol and gas will retain all water and sediment.

5. *Danger of Petrol.*—Petrol vapour is very inflammable and when mixed with air in a proportion of from 2 to 5 per cent. of vapour is highly explosive, particularly when under compression. Petrol vapour is moreover heavier than air and is therefore likely to hang about in sumps and holes in the ground for some considerable time. For this reason petrol requires special care in handling and storage and should never, under any circumstances, be exposed in the neighbourhood of any naked flame, or thrown down sewers and drains along which it may be carried on water and thus be the cause of a serious accident.

6. *Air Gas.*—A mixture of petrol vapour with air weaker or stronger in vapour than the above, while non-explosive, is still highly inflammable; the former produces by combustion a hot and non-luminous flame, and the latter a cooler but luminous flame. As, however, the dilution with air of the stronger mixture would tend to produce an explosive gas, the weaker mixture is usually employed commercially under the name of air gas, and is moreover so proportioned that all the air required for the complete combustion of the petrol vapour in the mixture is generally contained therein, and is supplied therewith through the pipes.

7. *Hygienic Effect of Combustion.*—The usual mixture employed contains from 1·4 to 1·8 per cent. of petrol, the remainder being air and this being all that is required for its combustion. Air gas has the great advantage of requiring little, if any, air from the room in which it is being burnt, while coal gas is said to vitiate the air to the same extent as three adult persons for each 50 candle-power burner used. Air gas, however, passes into a room the actual products of combustion in the same way as coal gas though perhaps not to the same harmful extent. This mixture moreover being so largely composed of air is almost free from smell and may be considered as unharmful to health and has no ill-effect on its surroundings.

8. *Danger of Air Gas.*—The absence of all smell has the one disadvantage of making leaks difficult to discover, but on the other hand should leaks occur the mixture is so weak in petrol vapour that any further dilution with air would render it innocuous and non-inflammable. In fact it is claimed by the makers that air gas cannot be ignited except at the proper burners, and it may reasonably be considered that the risk of fire is no greater with air gas, if as great, as with any other form of artificial illuminant.

On the other hand, owing to the fact that air gas requires no air for combustion, it can burn in a confined space and is liable to burn back along the pipes unless means are adopted to prevent its doing so. For this purpose all burners are provided with fine gauzes over the orifices which also serves to break up the gas for a more ready combustion. Such an accident as suggested above has actually occurred at Bordon, but its recurrence has now been rendered impossible by the introduction of gauze baffle plates in the main pipes where they leave the machine.

9. *Condensation in Pipes.*—It is claimed that air gas does not condense in the pipes, and this is substantiated by the reports of the many users

Digitized by Google

visited by the writer with the exception of a case of condensation at Bordon, in which case the cause of condensation is not easy to understand. It is suggested that moist air may have been sucked back into the pipes through burners, which had been left turned on during the day when the gas was not being made and then condensed in the cold pipes.

It is reasonable to expect that there should be no condensation, for the air in the mixture has by no means absorbed all the vapour it is capable of taking up and has, moreover, been subjected in the carburetter to the low temperature produced by the evaporation of petrol which is lower than any temperature it is likely to meet in the system.

In any case, although perhaps not necessary, it is advisable to lay all the distributing pipes to drain to certain points that can, if required, be examined.

10. *Burners.*—Air gas, as usually employed, being non-luminous, is burnt in special burners and is employed with the Welsbach mantle such as those already described under the heading "Coal Gas." These mantles are made in sizes varying from 25 to 125 candle-power each, and may be said generally to require about 1 cubic foot of air gas per hour per 10 candle-power. The burners are usually of the inverted type and are somewhat similar to the ordinary Bunsen burner, but since, as a rule the gas requires no more air for its combustion, the air holes of the ordinary Bunsen burner are in this case usually absent. The burners, which are so arranged as to reduce the pressure at the point of ignition to atmospheric pressure, are covered at the orifices by a fine gauze, and it is essential that this gauze shall be whole and clean in order to prevent the gas burning back along the pipes and to ensure a steady light. The accident already referred to as having occurred at Bordon, where in one case the carburetter exploded, is attributed to the gauzes having become clogged and then damaged by the men in the barrack room attempting to clean them.

11. *Pipes.*—Since the pipes used are required to carry the air necessary for combustion as well as the vapourized spirit itself it is obvious that they must be of fairly large size and no pipe less than $\frac{3}{8}$-in. bore should ever be used, while for 100 100-candle-power lights a pipe of 2 in. internal diameter is required. Some makers claim that the pipes used for coal gas lighting are sufficiently large for air gas but this is not strictly the case. The piping laid down in the first instance for the "Praed" installation at Fort George, Inverness, had eventually to be replaced by larger pipes, although, in this plant, a gas is employed richer in petrol vapour than is commonly the case. No great pressure is required in the supply of air gas, as the induction of air at the burners necessary with coal gas is in this case not usually required. About 2 in. of water column is generally sufficient or just enough to ensure that the gas shall be brought well up to the burners throughout the service. It is however, essential that the pipes should be well fitted and quite air-tight, and to ensure this screw joints are used. Any leaks or holes may be stopped with such a mixture as red or white lead mixed with gum arabic; red lead paint must not be used as the petrol vapour would in time wash out the oil and cause a leak. The arrangement of the distribution pipes is much the same as for coal gas and calls for no special remarks. At

Digitized by Google

Lydd the distributing system consists of a "tree" fed at one point from a "distribution box" into which the engines supply gas. The pipes of the system diminish in size as the load in each decreases and vary from 2 in. in the mains to 1 to 1½ in. in the services. At Fort George the system is similar with the exception that each pair of engines feed into the system at opposite ends of the main supply pipe. In all the installations visited by the writer the lighting is said to be steady and constant even in places remotest from the engine.

12. *Manufacture.*—Air gas is manufactured in special machines of which many types are now on the market, and which have proved very generally successful. The main principle of the modern air gas machine is to force well-filtered air into intimate contact with petrol either in its liquid or vapourized form in such a way that it shall become carburetted or impregnated with hydro-carbons to the required degree. In order to be able to regulate the mixture to the proportions required, means are always provided for the adjustment of the petrol or air valves, the strength of the mixture being regulated by the appearance of the flame of a pilot lamp. When the combustion is perfect this flame should be of a pale blue colour with a purple outer zone. A tinge of yellow indicates a mixture too rich in petrol, while too weak a mixture will burn, if at all, with an almost invisible flame.

13. *Engine Driver Plants.*—The machines now on the market are worked by small motors from ⅛ to ½ horse-power in size, which may be of any suitable type The usual motive forces employed are water, weights, and hot-air engines which burn gas from the machine itself or in larger plants a separate petrol engine.

The details of how such machines work may perhaps be explained by a brief description of some of the various types now in successful operation. It must not be supposed that the plants described in the following pages are the only reliable ones on the market, for there are many such plants as good and perhaps better. The examples taken have been merely chosen to show the general principles of manufacture.

(i.). *The Centenary.* (*See Fig.* 1 *of Plate*).

In this type, of which a plant is installed at Tidworth, a hot-air motor (*a*) drives by a belt a turbine generator or motor (*b*); this motor consists of a revolving drum immersed to just above its axis in a seal of water mixed with glycerine. The drum is divided radially into several sections and each section into three compartments as shown in *Fig.* 2. On revolving in the direction of the arrow each compartment in turn fills with air, which is brought into intimate contact with a regulated film of petrol floating on the water. As the drum continues to revolve the air in each compartment in turn mixes with the petrol, and is forced out through a central axial passage to a small gas holder of 2 or 3 cubic feet capacity which serves to maintain a uniform pressure. The gas holder when full throws the driving strap of the motor on to an idle pulley, and at the same time shuts off the supply of petrol to the motor and thus causes the manufacture of gas to cease until the holder drops again. The plant is simple and has given no trouble, but requires adjustment for any considerable change in temperature. The spirit used is specific gravity 0·715.

Digitized by Google

(ii.). *The Machine Gas Company.* (*Cox*). (*Fig.* 3).

The blower (*b*) driven by a hot-air motor (*a*) forces air through the carburetter (*c*) into which petrol led by gravity is allowed to drip and to spread on a revolving spiral of gauze from which it can freely volatilize. The air passing longitudinally through the carburetter becomes thoroughly mixed with vapour and passes out into a small gas holder (*d*) similar to the above. The gas holder regulates the manufacture by opening and closing an air escape (*e*) in the pipe supplying air to the carburetter and by shutting off the petrol valve (*f*). This plant also requires adjustment for temperature and this is effected by adjusting the rise and fall of the air escape (*e*), until the required mixture is obtained.

Four 150-light machines of this type have been installed at Fort George and two 75-light plants at Lydd, and have worked satisfactorily.

(iii.). *Non-Explosive Company.* (*Airalite*). (*Fig.* 4).

This is somewhat similar to the Machine Gas plant except that the carburetter (*c*) contains no moving parts and is so arranged that air passing through it in an upward direction passes over a series of superimposed plates on which petrol falling from above spreads and vapourizes. From the carburetter the mixture passes to a motor (*d*) which lifts petrol from the tank (*e*) by means of a small bucket wheel (*f*) and empties it bucket by bucket into the carburetter through the pipe (*g*). The gas then passes to a small gas holder, as before, which governs by opening and closing an air escape similar to the Machine Gas plant.

(iv.). *The National.* (*Fig.* 5).

In this plant air is driven by a blower (*b*) and hot-air engine (*a*) in two streams one of which (*c*) passes over a surface of petrol in the carburetter. This air becomes more or less impregnated with petrol vapour according as the flow is slow or fast and this mixture then passes through the gas valve (*e*) into the mixing box (*f*) where it combines with the other stream of air from the blower entering through the air valve (*g*). These two valves are controlled in opposite directions by the gas holder (*h*) to which the final mixture then passes in such a way that when the consumption is fast and therefore the mixture passing through the gas valve is weak the air valve is partially closed and the gas valve partially opened, and *vice versâ*. By this means a gas of uniform quality is obtained irrespective of load. The carburetter is warmed by the water from the cooling jacket of the engine which ensures the evaporation of all the petrol and is said to enable a spirit to be used of so high a specific gravity as 0·760.

A special feature of this plant is the "Thermostatic control" which is designed to ensure that the gas produced shall be uniform no matter what may be the fluctuation of the atmospheric temperature. The "Thermostatic control" is so arranged as to open or close a valve within the air valve (*g*) above mentioned, according as the temperature of the air rises or falls, for when the air is hot it may absorb a larger quantity of petrol vapour and will therefore require more dilution with air in the mixing box.

The plant is somewhat complicated and requires some looking after, but is very favourably reported on at Tidworth where a machine is

Digitized by Google

installed. The engine, however, is stated to take about one hour to start unless the cold water of the engine cooling jacket is replaced by hot water, in which case 10 minutes is sufficient to start the plant.

(v.). *The Aerogen Plant.*

The Aerogen plant is more or less a combination of the Centenary and the Non-Explosive Gas Companies machines and requires no special description. The plant installed at Aldershot in the Army Accounts building is favourably reported on, and, although only worked intermittently and at partial load, has given no trouble and is quick to start up. With this plant, storage capacity can be supplied and as the gas is rich, smaller pipes than usual can be used.

(vi.). *The Praed.*

The Praed plant makes a rich mixture which requires air at the burners. A plant of this nature at Fort George works well and successfully, but produces a very unpleasant atmosphere in the engine room. This plant will not work with petrol of higher specific gravity than 0·680 and appears to be somewhat wasteful in petrol, as it is said that one quart daily has to be drawn off and thrown away. It has the advantage, however, of a fairly large storage capacity.

(vii.). *British and Colonial.* (*Simpetrol System C*). (*Fig.* 6).

This plant, of which there is a 250 100-candle-power light installation at Bordon, differs considerably from any of the foregoing. In this plant, which is larger than the usual size, the only working parts are a ½ horse-power Gardner petrol engine (*a*) and a Roots blower (*b*) driven by it. The blower forces air into a rising holder (*c*) which by its rise and fall governs the admission of air by a valve (*d*) and thus ensures the pressure within it being kept constant. From the holder the air passes by two pipes in which are regulating valves (*e*) and (*f*) into any or all of three carburetting chambers connected in parallel, one (*e*) admitting air into the carburetter below the level of the petrol, the other (*f*) above. The petrol level in the chambers is kept constant by a float and needle-valve (*g*), and thus the air bubbling through the petrol has always the same depth to pass; the mixture in the carburetter is regulated when necessary to the flame of the pilot lamp by adjusting the two valves (*e*) and (*f*) mentioned above.

The plant works well with petrol of specific gravity 0·680, but soon chokes if spirit of any higher specific gravity is used. It moreover requires a man in constant attendance during the hours of running.

14. *Engine Rooms.*—All the above plants are worked by an engine and are accompanied by more or less noise. Some, however, may if preferred, be driven by weights or water power, which are quieter and less objectionable from this point of view. In any case, on account of the danger inherent in the use of petrol, it is advisable that engine rooms should always be placed apart from any other buildings. A small room of about 8 ft. × 8 ft. will usually be found quite large enough to take any ordinary plant with a separate small lock-up attached for the storage of petrol.

Digitized by Google

15. *Water-Driven Plants.*—Two water-driven plants seen by the writer are the Mitchellite and the Victor, and appear to be simpler, quieter and easier to maintain than those requiring an engine of any sort. They suffer, however, under the great disadvantage of requiring water perfectly free from dirt or sediment, however finely divided, as the smallest trace of foreign matter soon clogs the motor and causes the manufacture of gas to cease. These plants, moreover, consume a considerable amount of water, which must be under a pressure of at least 15 lbs. per square inch; for the smallest plants the consumption being from 4 to 16 gallons per 1,000 candle-power hours, at pressures from 45 to 15 lbs. per square inch.

Water-driven plants work much on the principle explained in *Fig.* 7, which is a diagram of the Mitchellite plant. A double-acting water piston (*a*) with a mercury-weighted throw-over valve (*b*) actuates an air pump (*c*) which drives air in the balance holder (*d*). From the holder (*d*) the air passes into the carburetter (*e*) where it is carburetted to the required degree and then passed away to the mains. The balance holder governs the plant by shutting off the water when the flow of gas ceases, and by controlling the inlet of petrol to the carburetter.

16. *Weight-Driven Plants.*—Weight-driven plants require a fall of the weights of from 20 to 30 ft. according to the size of the plant. These plants work much in the same way as those described above and deliver the mixture into a small gas holder in a similar manner. When the flow from this holder ceases, the holder rises to the top of its travel and closes a valve which stops the manufacture of gas. As the pressure against which the weights have to work increases beyond their power to overcome they are brought to a standstill until the flow of gas again commences and the holder in consequence falls.

17. *Comparison of Different Types.*—Weight or water-driven plants, provided the weights are wound up or the water supply constant as the case may be, have the great advantage of requiring no stopping or starting by outside agency, the simple turning on of any of the burners connected with the system being sufficient to start a flow of gas, which in itself starts the apparatus. Directly consumption ceases the water is automatically shut off, or the fall of the weight stopped, and manufacture ceases. On the other hand, engine-driven plants cannot start themselves, and before any light can be obtained gas must be made for the burner of the engine by turning the motor for a short time by hand. An engine-driven plant will, moreover, usually require to be stopped in the engine room itself, but in order to obviate the necessity for going out on a dark or wet night, plants can be fitted with a magnetic cut-off valve on the gas supply to the burner of the motor actuated from any convenient place within the house. The disadvantage, however, of not being able to start it again except by hand is always there.

18. *Storage of Gas.*—The absence of storage capacity (the majority of plants are only provided with a small balance holder) is undoubtedly a serious one, for if the engine stops but for a moment, all the lights go out and have to be relit. It is said that air gas will deteriorate if stored, but there seems to be no good reason why plants should not be provided with gas holders sufficient say for one hour's supply provided the gas is

Digitized by Google

only stored for a reasonable length of time. Such storage capacity is in fact provided with some makes of plant such as the Aerogen and Praed.

19. *Maintenance.*—All the plants now on the market are automatic once started, and it is claimed that no further attention is required beyond cleaning up after running. This is no doubt a just claim in the case of small installations in private houses where a groom or gardener can do in half an hour or less daily all that has to be done, but in the large installations required for barracks it has generally been found necessary to detail a man or men specially to look after the plant both by day and when working. It is also advisable that all lighting up should be done by specially instructed men as more mantles are damaged by careless lighting than are ever burnt out in fair use. The control of lights with air gas is much the same as with ordinary coal gas except that where all lights are extinguished at one time it is not essential that they should individually be turned off at the burners since any escape when again turned on is quite harmless and unnoticeable provided the burner is lit within a reasonable time. In some installations this practice is adopted and thereby much labour saved, while in others each light is carefully turned off when no longer required.

In England the working of the plants is looked after by the Royal Engineers, while the supply of petrol and renewal of mantles, globes and shades are in the hands of the Army Service Corps. Petrol is supplied to the troops as required, and a free issue is made of mantles at the rate of one per burner every six weeks in winter and every two months in summer, and of one globe and one mantle prop per annum.

20. *Fittings.*—The fittings supplied generally by the various firms are rather light and flimsy and not on the whole well adapted to barrack use. It is essential that the mantles shall not be subjected to undue vibration, and in India that the lights shall be protected from the wind of the punkah. The most satisfactory fittings are probably those now in use at Lydd, where the latest pattern barrack-room light (*Fig.* 8) consists of a flat circular enamelled iron air chamber suspended from the ceiling. The air chamber is divided in half horizontally and hinged, the lower portion supports a glass globe having a 1½-in. hole at the bottom for lighting. The gas is controlled by a lever worked by chains, marked "OFF" and "ON." These labels are specially necessary with air gas where there is practically no smell to indicate whether a lamp is off or on. The price of this fitting is 13s. 6d.

Small lights in passages, etc., are of the maker's standard pattern, enclosed in wall lanterns of the usual oil or gas lamp type. For outdoor use the globe of the lamp which must be waterproof and almost air-proof should also be protected from rain on account of its heat. This has been most successfully done by enclosing the maker's standard pattern indoor lamp within a lantern of the ordinary street pattern.

21. The light from the mantles is very intense and in the writer's opinion trying to the eyes when lights of over 50 candle-power are used. It is thought that the more powerful lights would be improved by a frosted glass shade. For officers' quarters, messes and similar places the maker's standard fittings would probably be found suitable so long as, in India, the burners are enclosed within globes so as to be punkah

Digitized by Google

proof. On the whole the fittings supplied by the Centenary Company appear as well designed and finished as any, and their pendants in particular are excellent, the lamp being supported by a flexible metal tube, in place of a rigid pipe, which tends to reduce shock to mantles to a minimum. In any case it has been found in practice that the rigid pendant with a mantle is unsatisfactory and that some "give-and-take" attachment such as the ball and socket joint should always be employed. Not only does the vibration of the ceiling, particularly if there is an upper floor, very soon destroy the mantle when rigidly connected, but the lighting, no matter how carefully done, sets up vibrations which speedily prove fatal. Such pendants are therefore not commonly employed in buildings containing more than one floor, wall brackets in this case being more generally used. The necessity for using brackets, which give less satisfactory general lighting than pendants, is not however supported by the evidence obtained from the three-storied barracks at Fort George where the mantles on such pendants as are fitted with the ball and socket joint are stated to have lasted quite as long as those fitted on brackets, while those attached to rigid pendants quickly perish.

22. *Scale of Illumination.*—The scale adopted with air gas in barracks in England appears to be very considerably above that authorized for India (1 candle-power per 20 square feet in barrack rooms). At Lydd, barrack rooms 60 ft. x 20 ft. or 1,200 square feet are said to be quite well lit by three nominal 100* candle-power burners equally spaced or on the scale of 1 candle-power to 4 square feet. This is, it is thought, undoubtedly excessive, a good and quite sufficient light being obtained with a scale of 1 candle-power per 12 square feet. For outdoor lighting nominal 100 candle-power lamps spaced 80 yards apart are found sufficient to light up barrack roads, while 40 candle-power lamps are used in latrines, closets, pantries, etc.

23. *Initial Costs.*—The following table compiled from the reports of various stations gives a rough idea of the cost of an air gas installation in barracks:—

Place and Use.	Firm.	Points.	c.p. of each.*	Total c.p.	Initial Cost.	Cost per pt.	Cost per c.p
					£	£	£
Fort George (Barracks)	Machine Gas Company (Cox).	621	80	49,680	1,578	2·54	·026
Bordon (Barracks) ...	Simpetrol	254	100	25,400	446·5	1·75	·0175
Lydd (Barracks) ...	Machine Gas Company (Cox).	176	100	21,600	656·5	2·56	·0304
		80	50				
Fort George (Barracks)	Praed	95	75	8,025	422	3·54	·0515
		12	50				
		12	25				
Tidworth (Concert Hall)	National	93	—	5,750	246	2·64	·043
Tidworth Institute ...	Mitchellite ...	67	60	4,020	194	2·9	·0483
Netheravon (Riding School).	Non-explosive (Airalite).	39	100	3,900	140	3·6	·036
Newhaven Barracks ...	Non-explosive (Airalite).	45	25	3,175	235	2·73	·074
		41	50				
Tidworth Gymnasium	Centenary... ...	37	60	2,220	52	1·4	·0234
Tidworth Sergeants' Mess.	Machine Gas Company (Cox).	27	60	1,620	52·00	1·93	·032

* The above candle-power ratings are the maker's figures, and are probably not attained in practice. The nominal 100 candle-power lamp may be said to give on an average a light of 80 candles, while the smaller lamps may be reduced *pro rata*.

Digitized by Google

24. *Recurring Costs.*—The actual cost of producing air gas is not a very easy matter to determine and most of the maker's claims must be taken with some caution. On the other hand, few of the installations in barracks have had a really long enough trial to exactly determine these costs, and very few private users keep accounts from which useful results can be deduced.

The following figures are given of the various stations named :—

Bordon. 1 year: 250 lights: 1,600 hours: at 55 c.p. per light candle-power hours ... = 22,000,000

			£	s.	d.
Petrol at 10d. a gallon	1,496 gallons	...	62	6	8
Mantles at 2s. 11d. per dozen ...	102½ dozen	...	24	19	0
Globes at 2s. 9d. per dozen ...	25 „	...	2	18	4
Sundries	... ...	...	0	9	6
Wages at 6d. per hour	...		40	0	0
Depreciation on £446 5s. at 5 per cent.	...	...	22	6	6
			£153	0	0

This works out to approximately 1·67 pence per 1,000 candle-power hours.

The figures reported from Lydd and Fort George are 1s. 7d. and 1s. respectively per 1,000 c.f. of gas, but as it is not known how many burners were in use, for how long they were burning and what the candle-power was, these figures cannot be reduced to a basis of comparison with other illuminants, for it is obvious that since coal gas requires five to six times its volume of air for complete combustion while air gas requires little, if any, a comparison on the basis of the cost per volume is of little practical use.

Tidworth reports a price per 1,000 c.p. hours, as follows :—

Mitchellite 1·1, Machine Gas 1·2–1·3, Centenary 2·4 (this being used in the gymnasium and therefore intermittently is probably the explanation of so high a figure), National 9.

On the whole it may probably be safely stated that air gas will cost something under 2d. per 1,000 candle-power hours.

(*To be continued*).

Digitized by Google

REVIEW.

THE STORY OF JERUSALEM.

By Colonel Sir C. M. Watson, K.C.M.G., C.B., M.A., etc. *Illustrated by* Genevieve Watson.—(London: J. M. Dent & Sons, Bedford Street, W.C. 1912).

Sir Charles Watson is so well known as the able and indefatigable secretary of the Palestine Exploration Fund, that any book coming from his pen dealing with the topography and history of the Holy Land is assured of a cordial welcome. This little volume, which may perhaps be regarded as an extension of the article in the *Encyclopædia Britannica*, is adapted for the use of the intelligent tourist who, in the case of a city of such ever-living human interest as Jerusalem, rightly demands something more than the best guide book generally supplies, and is content with something less than the original works of historian or archæologist.

The book opens with a description of the topography of the city site, illustrated by a map, which we may say at once appears to us the weakest part of the whole work. We presume that the cost of production prohibited the inclusion of maps printed in colours showing the positions of the walls at different times in the town's history, but, even excluding this possibility, the one map given appears to us quite inadequate.

The topographical description is followed by a somewhat naïve and uncritical summary of the early history of the city, taken direct from Biblical sources. Thus the old and now generally discarded version of the slaying of Goliath is quoted without comment. The author asks (p. 40) how to account for the sudden rise to greatness of the Israelite monarchy under David, and how did a simple shepherd boy obtain that influence over men which enabled him to carry his ideas into effect. The present place is perhaps hardly suitable for any detailed discussion, but we would suggest that the author should re-read his history in the light of modern biological research with a due recognition of the prime importance of inherited racial characteristics. Briefly we may state the case as follows:—In the highest degree of probability David was not a Jew, *i.e.* not of Semitic blood, but was probably an Amorite, a member of a fair-haired, blue-eyed, northern race. The Semitic races have never produced great rulers, and the rise of the nation to greatness under David was due to the subjection of the somewhat servile Semitic people to the virile and energetic northern character. If David was not a Jew *à fortiori* Solomon was not, it being very improbable that the wife of

Digitized by Google

a Hittite was of Semitic blood, and we have therefore the two great Kings of Israel virtually foreigners.

The history of the city is followed to modern times. Those interested in the problem of an oversea invasion may be recommended to study the story of the Crusades especially the seventh under Saint Louis. The King finding Damietta unprotected occupied it and remained there with his whole army for six months. He then moved inland with the result that he was completely defeated and his entire force either killed or captured.

The book is illustrated throughout by charming little sketches by Lady Watson, and we can cordially recommend it to any intending visitor to Jerusalem, or to anybody who wants a succinct and clear summary of the varied chronicle which centres round those rocky hills where so much of history that touches most closely the human family, has been enacted.

E.H.H.

Digitized by Google

NOTICES OF MAGAZINES.

KRIEGSTECHNISCHE ZEITSCHRIFT.

The April number contains an article by Capt. Von Blittersdorff on a new apparatus for signalling between the battery and the observing station.

It consists of a small box in a knapsack form, which can be easily carried on the back by a man either mounted or on foot. The box contains a white band some 8 ins. wide, wound on two rollers, and on this band the letters of the alphabet and 10 figures are clearly marked. On opening the lid of the box and turning a handle any desired number or letter can be quickly brought to view.

FIG. 1.—*Mode of Carrying Signalling Box.*

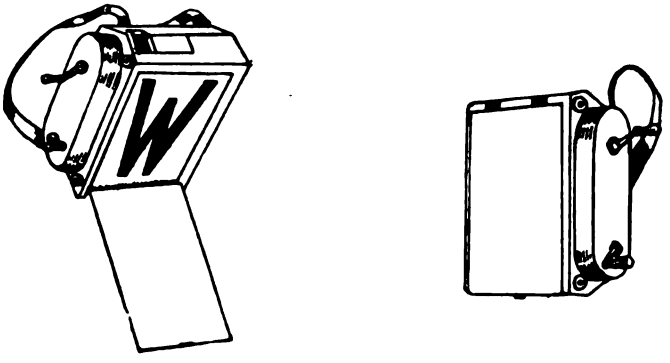


FIG. 2.—*Signalling Box—Open and Closed.*

Digitized by Google

The letters are about 10 in. × 7 in. in dimensions, and the writer claims that they are clearly visible with field glasses at ranges of from 500 to 1,000 yards according to the conditions of light and atmosphere.

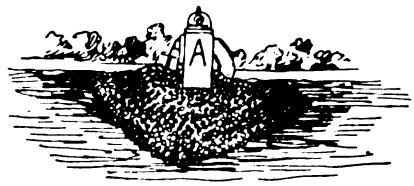


FIG. 3.—*Method of Signalling.*

The time taken to send a message by this means is only one-third of that required when signalling with flags.

The advantages of the apparatus appear to be as follows:—

1. Whereas as many as five dots or dashes may have to be sent and read for one letter by the Morse system, only one signal is here needed for each numeral or letter.

2. The changing into dots and dashes and back again, always a source of possible error, is avoided.

3. The signals can be sent and read by anyone and therefore can be at once grasped by all six guns in a battery, instead of having to be translated for them by trained signallers, and then conveyed to each No. 1, a process which involves loss of valuable time.

4. The employment of this method is not nearly so conspicuous as the ordinary "flag-wagging," and is therefore less likely to attract the enemy's attention.

5. The man who is signalling can keep well under cover, and therefore the apparatus is well adapted for signalling back from the firing line.

6. The setting up and dismantling of the new signal station is very quickly accomplished, as the man has simply to take the case off his back and can start sending messages at once.

In this particular it is a valuable supplement to the telephone which always takes some time to lay out, and especially so at critical moments, as for example when guns first come into action from a covered position and fire has to be opened at once. The telephone is also liable to break down, in which case the apparatus would be available as a substitute.

This method of signalling can also be used with advantage at night, if the letters are illuminated by means of an ordinary bicycle acetylene lamp or strong pocket electric light. Under such circumstances the letters can be easily read at a distance of 500 yards. In daylight the letters can be read with the naked eye up to a distance of about 200 yards.

C. OTLEY PLACE.

Digitized by Google

Rivista di Artiglieria e Genio.

On the Advantages of using Boats constructed of Thin Metal Plates for Bridge Equipment.—By Lieut.-General Pio Spaccamela.—For more than 20 years General Spaccamela has advocated the use of metal boats for bridge equipment, and he now returns to his argument with the absolute conviction that with such a change the greatest advantages will be obtained. This specially applies at the present day, as the progress in metallurgy admits of uniting two valuable conditions formerly at variance, viz., those of resistance and lightness. For instance steel plates can now be constructed $\frac{4}{10}$ths of a millimetre thick, with a resistance up to 70 k.g. per m.m., and this would allow of the construction of boats of great capacity and resistance, and of not great weight.

The reasons given against the change to the use of metal boats are the following:—

1. Greater difficulty in executing repairs, as compared with wooden boats.
2. Greater difficulty of preservation.
3. Greater difficulty of construction.
4. Greater cost.

But the experience of other armies shows that such difficulties may be easily overcome.

1. With regard to the first objection, it may be noted that it is based on the experience of some 60 years ago when metal boats were first introduced. At that time such an objection had a certain weight, but this is no longer so to-day, when the science of metallurgy is well understood in all civilized countries.

There cannot therefore be any difficulty in securing the services of a sufficient number of skilled workmen who are capable of repairing metal boats. On the contrary the regiments of engineers find some difficulty in recruiting an adequate number of caulkers, because, whilst the number of metal workers increases from year to year, the number of carpenters—and more especially those capable of repairing wooden boats—diminishes annually.

2. The second objection is that it is more difficult to preserve metal boats. It may at once be argued that they rust easily, and are constructed of thin plates which may be easily perforated. That steel plates may rust easily cannot be denied, but it is also true that they can easily be preserved from rust by covering them with varnish. If this varnish does not adhere to the plates, there is no difficulty in renewing it from time to time as required, and to omit such precautions only shows that little care has been taken, and that there has been little knowledge of the material on the part of those entrusted with the work. The Austrians, the Japanese, and the Russians, make use of varnish for their boats, and although it may not adhere very strongly it succeeds very well as a preservative against rust. On the other hand if this is not satisfactory, a solution of zinc may be used, as is done in the French and Prussian Armies.

Digitized by Google

3. The difficulty of construction is one that cannot have any value, in view of the fact that in late years boats constructed with steel plates have given good results for the equipment of bridges for both divisions of cavalry and infantry.

4. It is true that the plated boats cost more than wooden ones, but considering the advantages of better preservation, it would seem that after a period of 10 or 12 years the plated boats would cost even less than those of wood. France, which has to contend with rapid rivers, sometimes frozen (as for instance the Rhone), has decided on plated boats.

To the advantages of metal over wooden boats stated above there may be added

1. The carrying of a greater load with a less weight.

2. Less friction is presented to the current in the metal boats.

The first advantage is indisputable. At Pavia, two years ago, two boats plated with steel were constructed by the engineers, with the result that compared with wooden boats there was a superiority in the portage of ·200 cubic metres with a reduced weight of 65 k.g.

The resistance that a boat meets with depends in a great measure upon the friction of the water against the immersed surface of the boat. From recent experiments of Suppon, head of the steam navigation of the Danube, there seems to be no doubt that a wooden boat presents a resistance nearly twice as great as an iron boat of the same capacity, and it is well to note that the boats referred to by Suppon have a more wrinkled surface than those used in Italy. Wooden boats require to be kept in suitable places, neither too damp, nor too dry, and these are sometimes difficult to find, so that the boats required cannot always be reckoned upon as being ready for use. In fact it may be necessary to keep them in the water for two or three days to allow the wood to swell. All these inconveniences may be avoided by the adoption of metal boats.

The examples of France and Germany are instructive, the first having adopted metal boats of only one piece, and the second having completely modified the primitive plated boats, which in the old equipment had a length of 7·50 metres with a load of 6,000 k.g., and having substituted boats of only one piece, length 8·50 metres and a carrying capacity of little less than 10 cubic metres. Germany also has retained the boats of one piece only for the equipment of the army corps, but they are divisible into two for the equipment of the bridge divisions: thus obtaining the greater lightness and mobility which is so necessary for carriages which are required to accompany the troops on the march.

By adopting two kinds of construction of boats, that of one prow piece and one prismatic piece, a certain number of permutations and changes can be made which render the boats serviceable under any circumstances. Thus, the junction of one prow piece, and one prismatic piece will suit for constructing bridges on still water. The junction of two prow pieces is advantageous for casting and raising the anchor, for the transport of troops, and for all the manœuvres that require small boats. The junction of two prow pieces and one prism will give the boat such strength and length that it can be used even in rapid currents. Finally the junction of two prow pieces and two prisms will give even greater stability.

Digitized by Google

There are however many inconveniences in the divisible boats. For instance there is the necessity of joining the several compartments among themselves. This can be done when the construction is very exact, and the joints perfect, but after a certain time these become worn, and in any case the joints constitute an element of weakness in the boats. The supposed advantage that a boat constructed in compartments increases the facility of transport is more apparent than real. In fact the great length of the boat wagon does not depend only upon the length of the boat, but also on the length of the planks. As a means of transport for troops the divisible boat has less advantages than the boat of one piece. There is a loss of precious time in placing the parts separately in the water and in reuniting them. It is true that the boat in pieces is divisible into compartments, but this would probably not prevent a catastrophe, if one of the compartments became filled with water at the moment when the boat was carrying troops; nor would it serve to sustain a submerged bridge for active passage. For these considerations, and after many trials, the French do not intend to adopt the Birago boat.

Before going further it may be well to examine the calculations for fixing the number of wagons required for transporting the boats for the Austrian bridge equipment. With the last orders for such equipment a new carriage (pontonwagen) is said to have been adopted for the boat in two pieces.

Supposing that it is required to construct a bridge for which 30 boats are necessary. With the Austrian system about 52 wagons would be used Under General Spaccamela's system 30 boats only would suffice, and the greater mobility of a column of 30 wagons compared with one of 52 wagons is obvious. It may be added that a boat of one piece placed in the water is ready with the exception of being planked, while the boat in two pieces requires to be first of all joined together, sometimes two and two parts, sometimes three and three. It may be conceded therefore that the bridge constructed with boats in one piece can, under similar conditions, be more rapidly constructed than one with boats of two or more pieces.

The German Army, in endeavouring to find a bridge equipment that would allow of the passage of a load of even more than 5,000 k.g., has given preference to the boat of one piece.

Supposing that an autocar weighing 5,000 k.g. passes over a bridge of boats, and that the distance between the boats from axis to axis is 5·33 m.; applying the formula of Della Rooene :—

$$P = P' + P'' \frac{(L - C)}{L}$$

In which P is the greatest weight supported on the planking.

P′ and P″ the weights of the hinder portions and the fore part respectively which are supposed to be $\frac{3}{4}$ and $\frac{1}{4}$ of the weight of the wagon.

C = width of the car = 2·80 m., L the length of the planking = 5·33 m.

then P = 4,343 k.g.

and adding the weight of the superstructive equal to about 700 k.g. we have a maximum pressure of 5,043 k.g.

Digitized by Google

It might be contended that, in calculating an interaxis of 5·33 m., the width would be too restricted for bridges in strong currents, but at the trials made at the great manœuvres of 1911, a bridge of wooden boats was thrown across the Po with boats having their axis 5·33 m. apart and with a velocity of current of about 3 m., and an entire army corps passed over with autocars weighing about 4,000 k.g.

Before closing this article a comparison is made between the steel boats of the French Army, those used by the Germans and Austrians, and those proposed for the Italian Army. The Austrian boat of two pieces is 7·75 m. in length, height at the prow 1 m. and at the stem ·80 m.; weight 605 k.g. and the net load carried is 9,374 k.g. That of the Germans is 8·50 m. in length, height at the prow 1·10 m. and at the stem ·85 m.; weight 500 k.g., with a net portage of about 10 cubic metres. The French boat is 8·55 m. long, height at prow 1 m., in the centre ·80 m., at the stem ·90 m.; weight 750 k.g., with a net capacity of 8·95 cubic metres.

The boats proposed by General Spaccamela are of steel plates 7·70 m. in length, height at the stem ·90 m. and at the prow 1·15 m.; weight 510 k.g. with a capacity of 11,210 cubic metres and carrying a load of about 10,700 k.g.

The following are the relation of weight and portage:—

Austria ..... $\frac{9374}{605} = 15{\cdot}50.$
France ..... $\frac{8950}{750} = 11{\cdot}92.$
Germany ..... $\frac{10000}{500} = 20.$
Italy (proposed) ..... $\frac{10700}{510} = 20{\cdot}98.$

These figures would seem to show clearly that the boats of Austria, and France are inferior to those of Germany and those proposed for Italy. It is in fact clear that those who advocate the retention of wooden boats in preference to adopting boats of metal plates, close their eyes to progress, and condemn the Italian bridge material to a serious inferiority in comparison with that of other countries.

E. T. THACKERAY.

ENGINEERING.

21st June, 1912.

In this number Lieut.-Colonel J. T. Bucknill, late R.E., contributes an interesting article on the U.S. Battleship *Maine*. He makes a critical analysis of the finding of the recent Board appointed by the U.S. Government to report upon the cause of the disaster, and still holds to the theory he enunciated in 1898.

Digitized by Google

RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEWS OF BOOKS.

[Reprinted from *The Army Review* by permission of the Controller of His Majesty's Stationery Office.]

o o o o o

HISTORY.

BRITISH BATTLES—WATERLOO. By Hilaire Belloc. 206 pp. 8vo. London, 1912. Stephen Swift & Co. 1s. net.

This is the third of the series of monographs dealing with British battles, which Mr. Belloc is engaged in writing. The account of the four eventful days, into which the campaign of Waterloo was compressed, is given in the same clear and concise manner as distinguished those of Blenheim and Malplaquet, which have already appeared.

No attempt is made to enter into details which might obscure the main facts of each day's events, nor does the size of the book admit of more than a very brief examination of those points on which interest and enquiry have chiefly centred.

In reading this book the two features which strike one most are firstly the emphasis laid on the events of the 16th June, which the author truly describes as the decisive day of the campaign; and secondly, the many excellent little sketches, a good example of which is the one that shows the positions of the various divisions of the Anglo-Belgian Army as Wellington imagined them on the 16th June and as they really were.

TIRAH, 1897. By Colonel C. E. Callwell. 164 pp., 5 maps and plans. 8vo. London, 1911. Constable. 5s.

This is one of the series of "Campaigns and their lessons"; it furnishes the classic example of operations by a disciplined army against irregular tribesmen in a mountainous country such as the North-West Frontier of India, and gives the practical soldier a well-arranged and concise account in outline of the 1897 operations in Tirah, and the lessons to be learnt from them.

The value of the principles inculcated is intensified to-day by the better armament of the tribes in question; the lessons and criticisms clearly placed before the reader enable him to form useful conclusions in amplification of the principles laid down in Part I. of the Field Service Regulations.

THE CAMPAIGN OF GETTYSBURG. By "Miles." 202 pp., with 3 maps. 8vo. London, 1911. Forster Groom & Co., Ltd. 7s. 6d.

Much credit is due to the author, who is understood to be an officer of the Royal Engineers, for his clear and instructive account of this campaign. It is open, however, to the criticism that for the sake of clearness the controversial points, with which the campaign bristles, are too easily dismissed.

Digitized by Google

In the opening chapter the author makes no allusion to the alternative strategy, which would have sent Longstreet westwards for a movement to the banks of the Ohio. If that course had been adopted in May, Grant might have been forced to abandon his campaign against Vicksburg. Lee's invasion of Pennsylvania at the end of June came too late to exercise any influence upon the course of events in the Mississippi Valley.

"Miles" seems to have handled his authorities on somewhat eclectic principles. For the battle of the 1st July he frequently cites Doubleday's volume in the Scribner series. Yet in his review of that engagement he lays the chief responsibility for the Federal defeat upon Doubleday, a view evidently shared by Meade. It might therefore have occurred to him that Doubleday's version was rather likely to be of the nature of special pleading. Similarly in his account of the artillery duel, which preceded Pickett's charge of the 3rd July, after several quotations from Alexander, Longstreet's Chief of Artillery, he suddenly throws that officer over altogether and states that the artillery combat lasted without a break for nearly two hours, though Alexander's account makes it of considerably shorter duration. Nor has he apparently felt it necessary to attempt to reconcile the discrepancies existing in Lee's two reports of the campaign.

Had he consulted Alexander's "Military Memoirs of a Confederate," he would perhaps have modified the statement (p. 155) that "the salient at Cemetery Hill could not be enfiladed from either side, whilst the hill was itself so strong that there was no fear of its being captured, if held by good troops." For Alexander insists that this salient "offered the only hopeful point of attack upon the enemy's entire line," and again "it must ever remain a grave reflection upon the Confederate conduct of the battle that the weakest part of the Federal position was the only portion which was not attacked."

The view that Stuart was completely successful in his object, whilst fighting with Pleasanton in the Bull Run Mountains, seems hardly tenable. For it was due, in part at any rate, to Pleasanton's success that Hooker was enabled to cross the Potomac without Lee's knowledge. The writer also gives the Confederate President more credit than he deserves for the assistance which he rendered to Lee in this campaign. It is difficult to believe that Jefferson Davis regarded the invasion of Pennsylvania in any other light than as a gigantic raid for the purpose of relieving the Commissariat Department at Richmond.

The statement on p. 16 that the Potomac below Harper's Ferry was unfordable needs considerable qualification. How did Lee cross the river in the previous summer? On p. 78 Rock Creek is spoken of as 6 inches deep. "Inches" should be altered into "feet."

It has often been pointed out that, although popular and military interest in the battle of Gettysburg is now very great, no complete account of it has yet been written. The volume under review goes a considerable way to supply the want.

MY EXPERIENCES AT NAN SHAN AND PORT ARTHUR WITH THE 5TH EAST SIBERIAN RIFLES. By Lieutenant-General N. A. Tretyakov.

Translated by Lieutenant A. C. Alford, R.A., edited by Captain F. N. Baker, R.A. 312 pp., 6 maps, several portraits, plans and illustrations. 8vo. London, 1911. Hugh Rees. 12s. 6d.

The original Russian work appeared first in serial form in the *Voenni Sbornik* in 1909. The narrative has now been translated into English, with the author's permission and approval.

The book presents for soldiers a day-to-day record of the adventures of the author, and the regiment which he commanded. It is written on lines somewhat parallel to the naval narrative supplied in Semenov's "Rasplata," but devoid of the bitter lament as to "what might have been," which characterizes that volume.

It is the story of a soldier's life—told in straightforward soldier's language—amidst the stirring times in the Kuan-tung Peninsula from the commencement of the Russo-Japanese War to the fall of Port Arthur.

In the words of the preface, "we follow the fortunes of the General's own unit, we live with his men amidst the blood-stained wreck of their trenches on 203 Metre Hill, losing all

Digitized by Google

thought of the general conduct of the attack and defence of the fortress—in a word, we are transported from the dry bones of military history to the living realities of the battlefield."

Various references are given in footnotes alluding to or explaining discrepancies between the author's account and our Official History of the War; excellent maps which are included make it easy to follow the operations. It is a book which should appeal strongly to the regimental officer, more particularly to the infantryman. Not the least of its merits is the unassuming character and cheerful self-restraint of the author, who "rarely criticizes, but instead shows us everyone doing his best to make bricks without straw"—a narrative of daily combats and daily work, of duty well performed and honour well sustained.

Although chiefly valuable as a psychological study, the book throws much light on various problems connected with modern siege warfare. Commenting on the Japanese assaults in August, 1904, the author speaks of the importance of a preponderating artillery, and of the danger of exposing guns (p. 113). In several places he corroborates earlier accounts of the value of star rockets in repelling the night assaults which then took place. He emphasizes the value of barbed wire for entanglements, refers to the shortage of barbed wire at Port Arthur, and gives the places where it was used (p. 153).

On p. 146, he writes:—"It is indispensable to teach the infantryman field fortification thoroughly so that . . . he needs no supervision in war time. In the 5th Regiment not only the non-commissioned officers but the men also could point out where trenches should be constructed, and of what length and depth they should be."

By way of comparison, the following, taken from the writings of a French officer who was recently attached to the Japanese Army, is of interest:—

"The construction of shelter trenches is considered in Japan to be chiefly an exercise for N.C.O.'s (to teach siting, etc.), since, say they (the Japanese), regularity of trace, etc., is of small importance in such works, the soldier, instead of spending his time in constructing these, should learn to throw up more ambitious types of cover, *e.g.*, cover-trenches, traverses, machine-gun emplacements." A British officer corroborates this statement, as does also the practice of the Japanese during their most recent war, in which artillery and infantry often had to construct extensive cover without the aid or guidance of engineer personnel.

On pp. 204—205, General Tretyakov discusses types of hand grenades, and gives his reasons for preferring some to others.

On pp. 251, 256, 267, he describes instances of their use which would seem to prove that the reports of attachés underrated somewhat their material effect.

In several places—notably p. 271—he describes the terrible effects of the Japanese 11-inch howitzer shells.

As regards the explosion inside Fort Sungshu (Work No. 3), which followed shortly after the blowing up of the parapet, and killed many of the garrison, General Tretyakov states positively that about 1,000 hand grenades stored in an excavation were detonated by a Japanese shell.

The German General Staff account surmises that this catastrophe was due to a delayed mine explosion; the Russian account advances several hypotheses, but inclines to the view which is stated as a fact by General Tretyakov. Our history speaks (Vol. III., p. 119) of "some outside agency" as causing the explosion.

Turning to miscellaneous matters:—

On p. 145 the General says that a retreat is always started by one man . . . in most cases . . . physically weak. "Therefore," he continues, "it is essential to recruit soldiers from men who are physically strong."

Whilst warm in his tributes to the behaviour of the sailors who helped to hold 203 Metre Hill, he calls attention to the shortcomings of naval details for land warfare, and instances their deficiencies in outpost duties. He likewise warns against mixed detachments of any kind in a defensive line.

On p. 294, he gives a telling description of the peculiarly trying conditions of siege warfare.

The remarks on pp. 262—263 as to the type of officer needed for modern war are applicable to us no less than to Russia. . . . "What really matters is the spirit, the individuality . . . honourable pride . . . a sense of the high calling of an officer's profession . . . this is what every military man should have ingrained into his nature. Physical strength and health are also important factors; therefore officers must be encouraged to indulge in sports of all kinds."

Digitized by Google

POLITICS.

WAKE UP, GERMANY! (Deutschland sei wach). Anonymous; published by the German Navy League. 216 pp., with an index. 8vo. Berlin, 1912. Mittler. 1s.

This publication is one among many of its kind that have been sown broadcast in Germany during the interval between the Moroccan crisis of 1911 and the introduction of the Defence Bills in the spring of 1912. The attitude of the writer towards the question of Anglo-German politics is based, as in all works of this kind, on the hypothesis that German foreign policy is so transparently straightforward and pacific that no honest person has ever suspected it of being otherwise; while that of Great Britain is inherently aggressive and inspired by motives of self-aggrandisement, and the desire to pose as the supreme arbiter of European affairs. In the historical survey which occupies the first portion of the book this argument is elaborated in characteristic fashion. Among the many crimes imputed to England are that at the Vienna Conference in 1815 British influence prevented Prussia from receiving Belgium as "her well-earned reward," a significant phrase which is applied to Belgium more than once in the book; that by taking Heligoland from Denmark, Great Britain compelled Germany to purchase it in 1890 with territory in East Africa—the inference being apparently that if the island had remained Danish, it might have been had for nothing; and that having driven Turkey and Italy into a war in open pursuance of her own plans (sic) England has now cynically profited by the occasion to seize Sollum for herself.

The most important conclusion drawn by the author from the historical portion of the book is that Great Britain has persistently used sea supremacy as a stepping-stone to world supremacy; that with this object in view she has in the past allied herself with such of the weaker Continental states as were not likely to develop into competitors, in order to defeat the Power most immediately dangerous to her ambitions; and that she has in this way repeatedly overthrown her rivals, with a comparatively small sacrifice of personnel, though at the cost of a lavish expenditure of money. The writer labours to prove that England endeavoured in this way, notably in 1890, to use Germany as a "Continental sword" against Russia when the latter Power's advance towards India was causing her anxiety; and that, having been foiled in this attempt by the shrewdness of German statecraft she began in 1895 to seek a counterpoise for Russia in the growing power of Japan. It was at the beginning of the 20th century, we are told, that Great Britain decided that the position of *primus inter pares* among the world Powers could no longer satisfy her ambition, and that the whole world must henceforth be brought permanently under the British sceptre; the only obstacles to this plan were the rising commercial and maritime prosperity of Germany, and the forward policy of Russia in Asia. It was to meet the latter peril that Great Britain abandoned the "splendid isolation" to which she had clung for a century, and contracted the alliance with Japan in 1902. Though the Russo-Japanese War was thus waged in her interests, Great Britain still contrived to keep on good terms with Russia's ally, and to draw her into an *entente*, thus acquiring the long-desired "Continental sword" against Germany. The meeting at Reval, and the *entente* with Russia were, the writer asserts, prompted solely by the blind Germanophobia of British statesmen, who sacrificed their real interests in the Middle East in order to combat those of Germany. All suppositions that the policy of *ententes* may have been based on defensive rather than on offensive considerations, or that the fears of a German invasion were anything more than a mask for aggressive designs are rejected as the merest subterfuges. Similarly all talk about British trade interests or the traditional sympathy of England for oppressed nationalities is regarded as transparent hypocrisy.

British policy, the author insists, is essentially aggressive and domineering, governed solely by antagonism to Germany, and, in recent years, by chagrin for her failure to play the arbiter in the Bosnian crisis. The naval war scare was, we are told, merely an election cry for the Liberal Party (sic) in 1909. On the other hand, the phrases "preservation of peace" or "defence of her interests" are put forward to prove the purely defensive nature of any action, however militant, on the part of German diplomacy.

By a somewhat circuitous argument the author lays the responsibility for the growth of the

Digitized by Google

German fleet at the door of England. He quotes the famous *Daily Telegraph* interview to show that Germany considered herself unable, in 1900, to join in a coalition against Great Britain, owing to the risks to which the German troop transports plying between Europe and China would have been exposed in a war with a stronger maritime Power. The realization of this fact brought home to Germany the need for strengthening her navy. Hence, the author naïvely concludes, England, by means of the Boer War, was actually responsible for the development of German sea power.

Turning next to the strategical aspect of the question, the author is faced with the problem of finding a reason for an increase of the navy without giving any handle to accusations of aggressive designs. The general line of argument is as follows:—At the time of the Moroccan crisis of 1905, when war between France and Germany appeared imminent, it was decided to land a British force at some point on the Jutland coast; the existence of this project is held to account for the visit of the British fleet to Esbjerg and the landing of parties (sic) there, and on the east coast of Jutland. On this occasion, however, war was averted because France found herself unprepared. The question of British military action in aid of France continued, however, to be discussed, and it is this problem which, in the author's opinion, underlies the frequent reforms, or rather the continuous reorganization, of the British Army. French statesmen insisted with reason that Dreadnoughts could neither go to Berlin nor steam up the Meuse Valley, while, on their part, the English became more and more convinced that the security of Great Britain depended on a defeat of the French Army on the land frontier being adverted at all hazards. The scheme of a landing at Esbjerg was, however, abandoned, both because it would be too eccentric to be effective as a diversion, and because, unless the German fleet was absolutely blockaded in its ports, the transport of an expedition to the Jutland coast would be impossible during the first stage of a war. A landing in French territory might have appeared safer, but this plan again suffered from the defect that the force would be unable to reach the scene of action within the decisive period. It was therefore resolved that the British should land in Belgium and act in conjunction with the left wing of the French Armies.

That this plan had been agreed on is held to be confirmed by the protests raised in England against the fortification of Flushing by the Dutch.

This landing in neutral territory would be excused by England on the ground that Germany was herself contemplating a violation of Belgian neutrality in order to outflank the left wing of the French line. Here the author pauses to disclaim any such intention on the part of his country, but adds that Germany must be prepared at the first news of the embarkation of troops in an English port to take vigorous action in Belgium in anticipation of the enemy's plan; it would be of vital moment to Germany to oppose the landing of the British force, and its junction with the French left wing.

It is in this stage of the operations that the German fleet can play a decisive rôle. British strategy will, in the author's opinion, consist at the outset of the war, in "sealing" the North Sea with vessels of secondary importance, while the main fleet remains concentrated in a central position whence it can strike at the German fleet, whenever the latter should put to sea.

This strategy will, however, be seriously hampered by the necessity of covering the transport of the Expeditionary Force to the Scheldt. The British fleet will thereby lose much of its freedom of action, and will tend to remain in the western part of the North Sea, leaving the eastern coast of England exposed. If, however, the German fleet is skilfully and vigorously handled, command of the sea sufficient to ensure the safe transport of the British force may not be attained by England for some weeks after the commencement of war, that is to say, not until the assistance of this force will be too late. A great advantage of this plan, from the author's point of view, is that the German Army will thus be relieved of a possible danger without having become in any way weakened in the process. The German Navy must, therefore, be strong enough not only, as in the past, to cause grave risk to any naval Power venturing to attack it, but henceforward to prevent the transport of British troops to the Scheldt during the first stage of the war. For this purpose, it is pointed out, absolute strength is far more important than relative strength, so that a corresponding increase of the British navy need not affect the success of the strategy outlined above. The author predicts that if the German fleet can be strengthened to the required point, the British projects for sending troops to the aid of France will have to be abandoned; Great Britain will then be thrown

Digitized by Google

back on the expedient of a protracted and inconclusive war against German commerce, while France will become convinced that the British alliance can do nothing to save her from defeat on land. A "re-grouping" of the Powers is then certain to follow: in other words, France will range herself on the side of Germany. The author lays great stress on this point, maintaining that France has already lost golden opportunities through her subservience to British policy, and that once the conviction has gained ground that England is powerless to help her the logic of facts will prove stronger than the logic of sentiment.

Turning to the Baltic, the author finds fresh arguments for an increase in the navy. The attitude of Russia in a war between Germany and the Western Powers is, he thinks, difficult to predict. It is most improbable that Russian statesmen would agree to fight Germany unless Russian interests were at stake, or, in any case, that they would consent to Russia's acting as a "Continental sword" for England; assurances were interchanged at the Potsdam interview in 1910 that neither Russia nor Germany would join an offensive coalition directed against the other. The recent strengthening of the Russian Baltic fleet has probably, he considers, only been undertaken at the instigation of Great Britain and France in order to induce Germany to weaken her squadrons in the North Sea. Nevertheless, he continues, the dislike of the Russian people for Germany cannot be overlooked; nor can the recent withdrawal of Russian troops from the frontier of German Poland be interpreted as a sign of goodwill to Germany, as this step was no doubt primarily due to considerations of mobilization. The increase of the Russian fleet must therefore be taken into account as a new factor; Germany can no longer concentrate her full strength in the North Sea against England, while the latter Power, thanks to her *entente* with France, can now unite her whole force against Germany, a condition which was assumed to be impossible in the Navy Bill of 1900. Only a treaty with Russia, the author concludes, can relieve Germany of this anxiety as to her position in the Baltic.

With regard to the Mediterranean, the author observes that Germany is the only Great Power which has no direct voice in Mediterranean questions; nevertheless her interests are those of Austria and Italy. The withdrawal of British ships to the North Sea to make head against Germany's growing strength in that quarter—though in one sense a victory for Germany—has given France a predominant position in the Mediterranean; the strengthening of the Austrian and Italian fleets offers some counterpoise to Franco-British supremacy, but only so long as Austria and Italy put aside sentimental rivalries and co-operate in support of their true interests. Meanwhile, Germany must realize that in case of a European war her navy will have to contend alone and unsupported against the fleets of Great Britain, France and Russia.

As regards pacification in general, and the limitation of armaments, the author favours arbitration treaties of limited scope, as tending to eliminate wars on secondary issues, but urges that any form of unlimited arbitration before an international tribunal is incompatible with the sovereignty of the State. Germany, he says, has to provide for an annual increase of 900,000 inhabitants; for these she requires elbow-room both politically and commercially, a right which has recently been denied her with menaces of war. She must now decide whether she will be content with the limited rôle of a European Power, or assume her rightful place as a World Power; in the latter case she must be prepared to make sacrifices both of money and blood, to withstand the enemies who are seeking to hem her in. No agreement to limit the development of her fleet can, he insists, be contemplated by Germany; the initiative for any such step should, he contends, properly come from Great Britain as being the stronger Power, and yet Great Britain has never made any definite proposal—an argument which appears somewhat disingenuous considering the result of our last attempt in that direction.

Finally, the author, after gratuitously asserting that Englishmen of high position have endeavoured to induce the United States to join Great Britain in opposing the development of Germany, makes a proposal that this country and Germany should develop their empires in co-operation instead of in antagonism. Expressions of this sort occur from time to time in the book; whether inserted by another hand or intended to produce an impression of open-mindedness and impartiality, we do not know. It can only be said of them that they are little in harmony with the author's theme. Even admitting that a book which is written with the object of enlisting support for a particular measure is not to be judged by the ordinary standards, it is difficult to see what object can be served by the dissemination of literature of this sort, except—to quote Herr Haussmann's indictment of the German Navy League—"the propagation of fear of England and antagonism to England."

Digitized by Google

RAILWAYS.

RAILWAYS IN WAR. By Colonel Domelunksen, Russian General Staff. 217 pp., with numerous plates. 4to. St. Petersburg, 1908. General Staff Press. 6s. 3d.

Colonel Domelunksen was in charge of troop movements on the Trans-Baikal and Circum-Baikal Railways during the Russo-Japanese War, and he has written his book primarily for the military student.

He divides his subject into three parts; he deals first with broad-gauge railways (Russian gauge, 5 feet); then with light railways worked by locomotives; and lastly with horse-traction tramways. In the opening chapter the author describes the construction of permanent way, and gives details of station equipment, rolling-stock, and line maintenance generally. Traffic management is described in Chapter II. The movement of troops by railway in peace and war, and the special expedients for coping with heavy military traffic, are dealt with in Chapters III. and IV.

Railway management generally and the duties of the military officials who supervise Russian railway traffic are included in Chapters V. and VI.

The method of constructing, equipping, and working a light railway of 750 millimetres (29·5 inches) gauge is given in Chapter VII. The horse-tramway described in Chapter VIII. is also of 750 millimetre gauge; data are given of various makers' types of rail and rolling stock, and of the means adopted for laying the track rapidly and for working the completed line.

STRATEGY AND TACTICS.

THE DOCTRINE OF NATIONAL DEFENCE. (La doctrine de défense nationale). By Captain Sorb. 416 pp. 8vo. Paris, 1912. Berger-Levrault. 6s.

Captain Sorb's new book—the greater part of which has appeared in serial form in the *Revue Militaire Générale*—practically amounts to an appreciation of the international situation in Europe from the military, and to some extent from the naval, point of view.

Such a study involves consideration of the military and naval potentialities of Germany, France, Great Britain, Russia, Austria, and Italy. This is a very great undertaking, involving as it does a close acquaintance with the strategical schools of thought in the countries concerned, intimate knowledge of the organization and mobilization arrangements of their armies, as well as statistics on the railways and roads of the whole of Europe. In addition, the tendency of the foreign policy of each of the countries concerned must be correctly fathomed, and the financial consequences of a vast European war must be estimated. It is extremely difficult for a private individual to compile a work of so wide a scope, and this fact should be borne in mind by readers of this interesting and courageous book.

Captain Sorb is of opinion that the policy of the Germans will be to force a decision with the least possible delay in order to crush the French Army before the intervention of the Russian and British Armies has become effective. Therefore, from the purely strategical point of view it would be advantageous for the French to postpone a decision as long as possible; on the other hand, if this postponement were to involve a general retrograde movement of the French forces and the abandonment of a considerable portion of French soil to the German armies, the advantages to be gained would be more than counterbalanced by the injurious moral effect produced in France and among the nations friendly to France. The solution suggested is the organization of a line of resistance not far removed from the French frontier, followed by a decisive counter-offensive viâ either Toul or Verdun, according to the situation. Stress is laid on the importance of winning the first battle; in fact, the author is of opinion that the result of the first battle will decide the campaign, a view that has already aroused considerable opposition in French military circles.

Not the least interesting portion of this book is the chapter dealing with the Anglo-French entente. The effect of Lord Haldane's reorganization is followed in some detail, and numerous extracts are given of the speeches of British statesmen and military writers. The

Digitized by Google

author finally comes to the conclusion that although the entente may provide valuable assistance to France in case of war, it is undesirable to transform the entente into an alliance, firstly because the function of our Expeditionary Force is still uncertain, secondly because Great Britain might be tempted to precipitate a war in which the French Army would be forced to act as the "soldier" of England.

Although, as has already been said, the scope of the book is perhaps a little ambitious, it is full of most interesting matter and provides much food for thought. The Morrocan crisis of 1911 has produced a host of literature on strategical subjects, among which "La doctrine de défense nationale" takes a high place.

BOOKS RECEIVED.

TRENCH'S MANŒUVRE ORDERS, 1912. Eleventh Revised Edition. By Major B. M. Bateman, R.G.A. William Clowes & Sons, Ltd., 23, Cockspur Street, S.W. 1912. 2s. net.

MILITARY HYGIENE AND SANITATION. By Col. Chas. H. Melville, R.A.M.C., late Secretary and Expert on Sanitation, Army Medical Advisory Board, W.O., etc., etc. Edward Arnold. London, 1912. 12s. net.

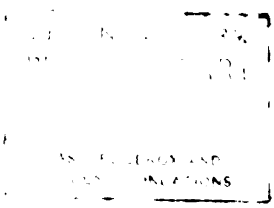
THE PRINCIPLES OF STRUCTURAL MECHANICS TREATED WITHOUT THE USE OF HIGHER MATHEMATICS. By Percy J. Waldram. B. T. Batsford, 94, High Holborn. 1912. Price, 7s. 6d. net.

THE CIVIL ENGINEERS' COST BOOK. Compiled for the use of Civil and Municipal Engineers, Public Works Contractors, etc. By Major T. E. Coleman, Staff for R.E. Services. E. & F. N. Spon, Ltd., 57, Haymarket, London. 1912. Price, 5s. net.

GUNNERY: An Elementary Treatise, including a Graphical Exposition of Field Artillery Fire. By Jennings C. Wise, B.S., Captain and Adjutant, First Battery Field Artillery, Virginia Volunteers. B. F. Johnson Publishing Co., Richmond, Va. 1912.

Digitized by Google

Digitized by Google

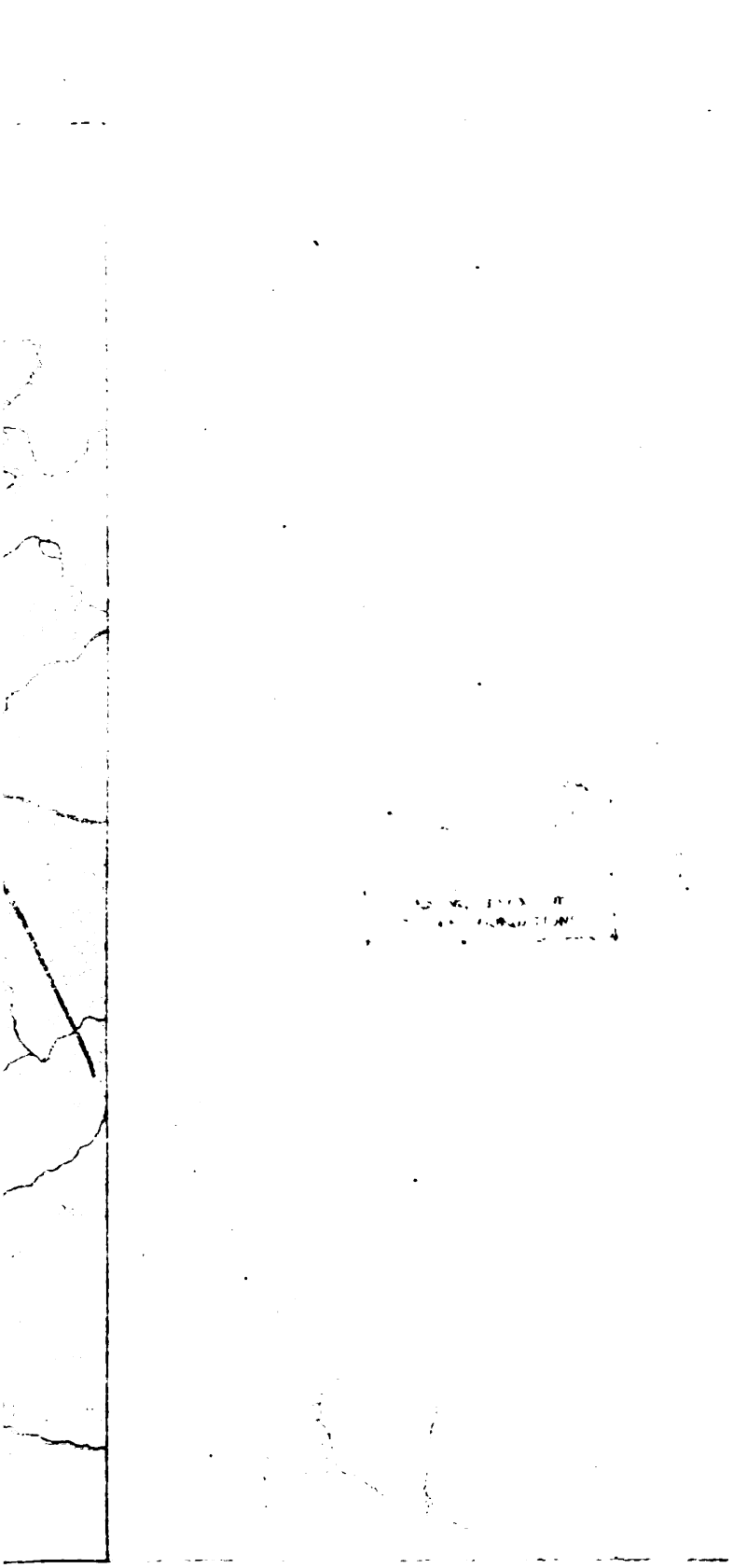


Digitized by Google

Digitized by Google

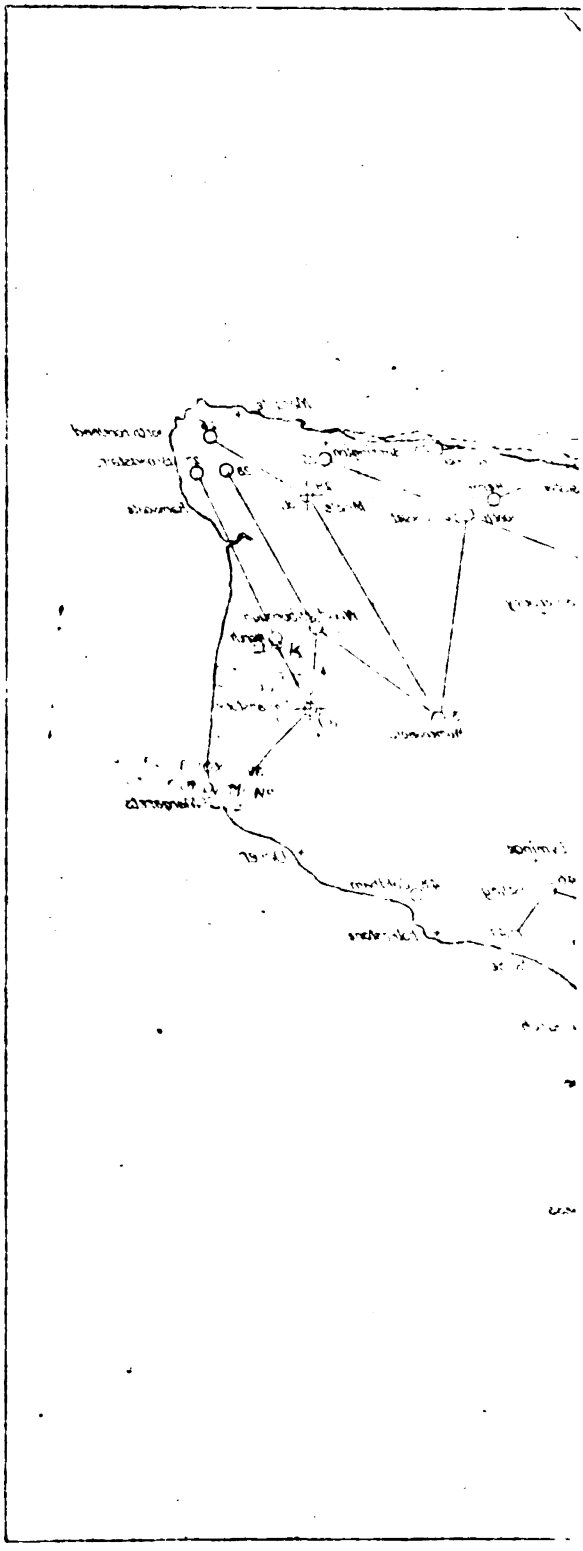
Digitized by Google

Digitized by Google



Digitized by Google

PLATE III



Digitized by Google

PLATE IV.

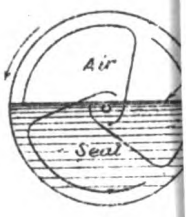
Digitized by Google

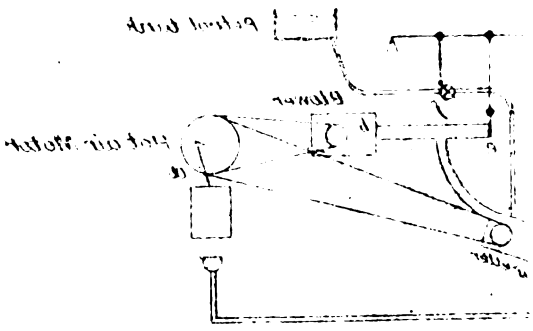
Digitized by Google

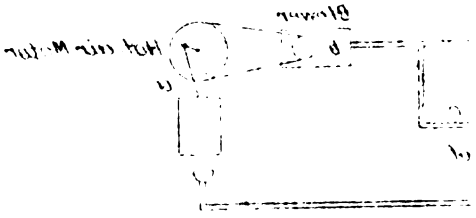
FICIAL ILL

GRAMS OF AIR-

FIG: 2.



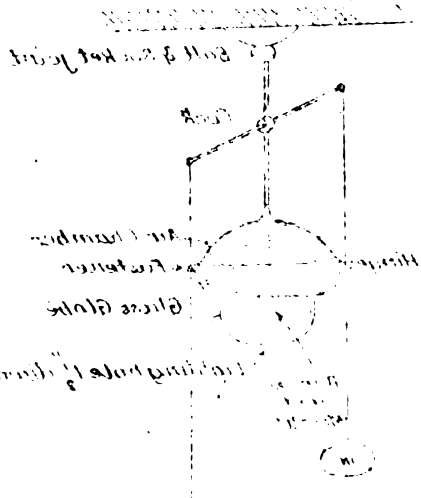




Hot air Motor
a

H.P. Gardiner
Petrol Engine
a

Level



Digitized by Google

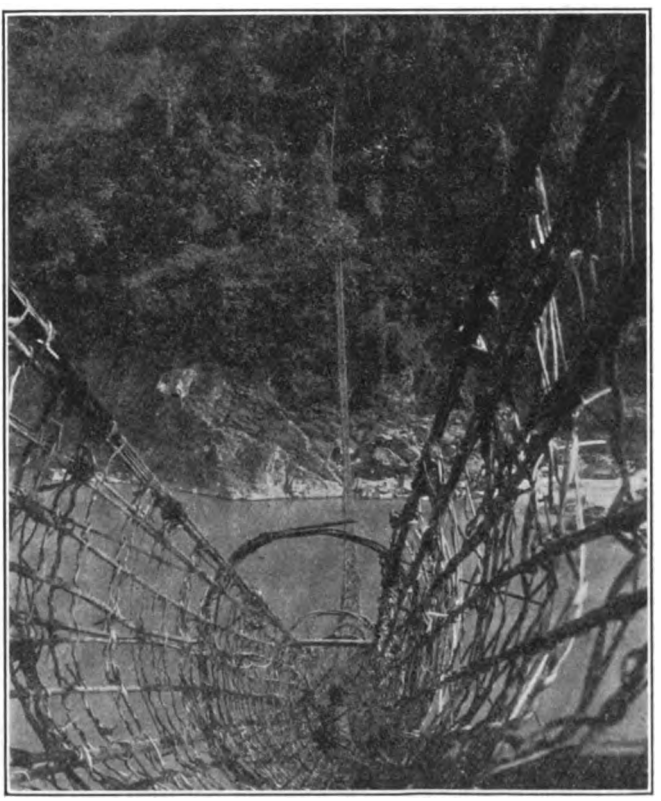
Digitized by Google

ABOR SUSPENSION BRIDGES.

By Lieut. A. F. Chater, R.E.

In a recent number of the *R.E. Journal* an article appeared dealing with bridges of various designs constructed by the natives of the Kachin country. The author stated that cane suspension bridges up to 80-ft. span were met with. The accompanying photos will be of interest to readers as showing up to what spans these bridges can be constructed.

No. 1 gives the end elevation of the largest of the bridges spanning the Dihang River. The span is about 700 ft. Dip 50 ft., height above river 50 ft.

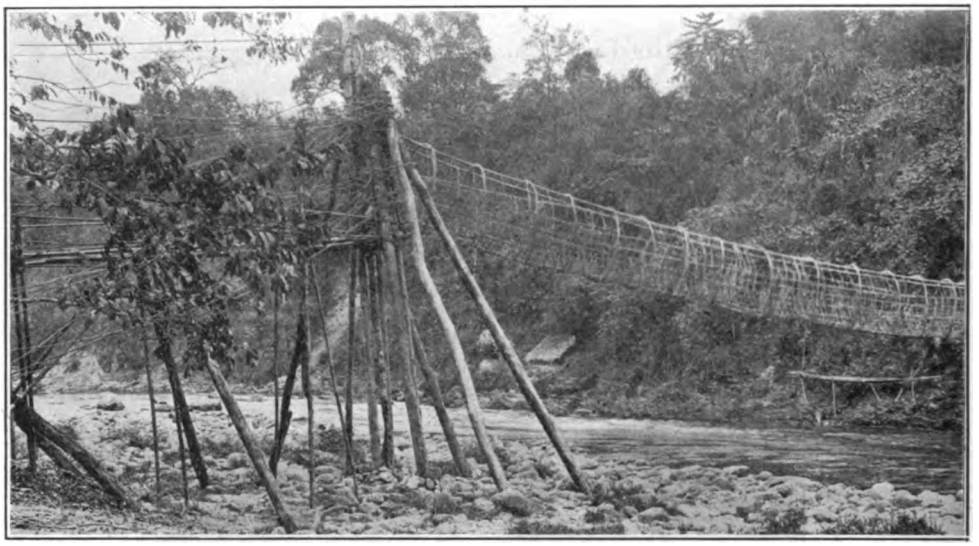


1. End Elevation of Bridge over River Dihang.

Digitized by Google

Nos. 2 and 3 show a smaller bridge of the same type and give a good idea of the design.

I will only add that rope, wire, nails, or iron of any description find no part in the construction, the only materials used being bamboo, cane, and timber found in the jungle on the site.



2. ABOR BRIDGE OVER A TRIBUTARY OF THE DIHANG.

3. ABOR BRIDGE OVER A TRIBUTARY OF THE DIHANG.

Digitized by Google

CONCENTRATION OF TROOPS BY RAIL.

By MAJOR H. F. E. FREELAND, M.V.O., R.E.

THIS paper is an attempt to put together very briefly the more important considerations which govern the preparation of a scheme for the concentration of a Force of all Arms by rail, and to indicate generally how such a scheme can be presented in an intelligible manner to those who will be required to put it into operation.

The subject is approached from the Indian standpoint, and it is not proposed to investigate the functions of a railway in the enemy's country, or the organization and working of the temporary lines which it may be found desirable to construct after the concentration of the Field Army on the Base of Operations has been concluded.

It should be remembered that the railways of India, except in the case of the main lines in the vicinity of and leading to the great seaports and capitals of provinces, are for the most part single lines of the 5-ft. 6-in. or metre gauges, and that distances in India as compared with those in the British Isles are very great. A further difference of conditions exists in that every force that is to take the field in India must be accompanied by its animal transport, mules, camels or bullocks as the case may be, and to concentrate this species of transport on the Base with all its equipment and forage greatly adds to the number of trains which must be run during the period of concentration.

In order that all the difficulties may be searched out in peace time, very close and harmonious co-operation between Army Headquarters and the various Railway administrations is essential. It has accordingly been the practice of recent years for an R.E. Officer with Railway Traffic experience to be attached to Army Headquarters for the purpose of working out the railway details of all such schemes in consultation with an officer of the Quartermaster-General's Branch. This arrangement has proved eminently satisfactory, and it would appear desirable that such an appointment should be made permanent, in order that existing schemes may be constantly under review and may be brought up to date as new railways are built and conditions alter in other directions; moreover it is very important that the officer who has been responsible for a scheme in peace time should also take a leading part when it is put to the test of war.

Assuming then that a connecting link between the army and the railways has been arranged for in the shape of this Special Officer, the next question is how is he to set to work. It will be admitted that all schemes for concentration must primarily be based on the

Digitized by Google

requirements of strategy, which will definitely determine the number of days, after the outbreak of war, available for placing a force of a given strength in a certain strategic position on the map, so that it may co-operate with other forces in taking up a defensive line or acting on the offensive against the enemy. Working back, the Line of Communications by road must then be tested, and an estimate made of the number of days which will elapse between the time the first troops leave the Railway Base and the last troops and transport arrive at the strategic point.

Having obtained a very clear idea of strategic requirements and of the capacity of the Line of Communication roads, the Special Officer may then commence to estimate the capacity of the Railway on which the Base Station is situated. It is obviously unsound to carry troops and transport to that station more rapidly than they can be cleared from the platforms and station premises, and it is also questionable whether it is advisable to take full advantage of the capacity of the Terminal Railway when by so doing the Line of Communication roads will become heavily congested. The curtailment of civil traffic to an infinitesimal quantity, as is certain to be demanded on the occasion of a great military concentration, will cause economic and political unrest, if not serious hardship among the population of the country in the vicinity of the Base, and it is wise to mitigate such conditions, as far as it is possible to do so. Bearing this important consideration in mind, and before the Military Authorities can be expected to state their requirements as to the number of trains per diem into the Railway Base it is necessary to know how many vehicles per train railways will consent to haul and precisely how many men, animals, guns, etc., can be loaded in the different classes of rolling stock.

Prior to 1910 all concentration schemes in India were based on a maximum load of 30 broad gauge vehicles per train; how this figure was arrived at is not on record, but it was a most inconvenient limit in that it necessitated the breaking up of units far more than was reasonable or desirable. For example on the 30-load basis a British Infantry Battalion occupied 1⅓ trains and other units were similarly affected. Recently however, the majority of broad gauge railways have agreed to increase the load from 30 to 45 four-wheeled vehicles and all schemes are now drawn up on this basis; the change meant, of course, some reduction in speed, but the balance of advantage is on the side of the greater load, which somewhat decreases the number of trains and consequently the number of engines required to haul them.

This decision was not arrived at without a great deal of argument for and against, but, in view of the fact that the great broad gauge lines of India are now equipped with a very large proportion of powerful locomotives capable of hauling 800 to 1,000 tons, that the increased load makes it possible to send whole units to the front

Digitized by Google

in one train and that the period of railway concentration is appreciably shortened, there is little doubt that the change was justified.

In order to ascertain precisely how many men, horses, mules, camels, bullocks, carts, guns, limber and wagons, could respectively be accommodated in each vehicle of the different classes of rolling stock, extensive entraining experiments were carried out on the North-Western Railway in the Spring of 1910.

Railways are constantly increasing the number of goods and coaching vehicles in their possession to meet rising traffic, and the design changes greatly as time goes on and conditions alter; it will not be safe to assume that, because a certain number of axles, for example, could be loaded in an open truck five years ago, therefore those figures can be accepted to-day. Loading and unloading experiments must therefore be carried out from time to time, and apart from their actual usefulness in determining the capacity of railway vehicles, and in practising units in the art of getting in and out of trains smartly, they enable the military and railway staff to estimate the time required and discover any defects that may exist in the design or equipment of the vehicles themselves. As an example may be quoted the case of horse wagons; these are equipped with movable breast-bars, which, when the vehicles are in use for carrying goods, are carried on brackets over the wagon doors. They are attached to the walls of the wagon by chains, but experience proved that the attachment was too weak, for when the cavalry soldier, in the act of loading his horses, had repeatedly barked his shins over the suspended bar, he adopted the simple expedient of wrenching it from its fastening and depositing it out of harm's way on the platform before commencing loading operations; the next time the vehicle was required for loading animals, the bar was generally missing.

The loads of trains and the capacity of rolling stock have accordingly been brought up to date, and are detailed in Load Tables and Field Service Regulations, and the Q.M.G.'s Branch is therefore in a position to estimate the precise number of trains required to place any given force with its transport on the Base of Operations.

Thus, after full consideration of the foregoing conditions, Army Headquarters can decide what is the minimum number of trains into the Base Station which will fulfil requirements, and the Terminal Railway will be asked whether they can do it. The Terminal Railway, it should be explained, is that on which the Base is situated; all other lines will act as feeders to it and will not be congested at any point in such a degree as the main artery near the Base.

It will now be the business of the Special Railway Officer, above referred to, to explain matters to the Terminal Railway Officials, and by personal investigation to ascertain whether their equipment and other facilities are sufficient.

Digitized by Google

The first matter for consideration is the working capacity of the line near the Base in trains per day. The line may be single or double, according to the density of the normal civil traffic; it may be taken however, that a single line will in most cases meet requirements, and will be used here for the purposes of illustration.

What, then, is the capacity per 24-hour day of a single line in trains running at an average speed of 18 miles an hour, this being the speed at which a load of 45 four-wheeled loaded vehicles can be hauled under normal conditions of grade and weather, assisting engines being supplied where gradients necessitate them.

The number of trains per day depends on the time taken to run over the longest distance between stations, and from this an approximate estimate of the total can be arrived at. Assuming that all trains will be run at a level speed, and that the longest distance between stations is $10\frac{1}{2}$ miles, the maximum *theoretical* number of trains that could be run would be one each way in $2\left(10\frac{1}{2}\times\frac{60}{18}\right)=70$ minutes or in other words 20 trains each way in 24 hours.

In practice, however, one train a day, the mail, will be run at a much faster speed; time allowances also must be given for empty trains returning *from* the Base to cross the loaded trains *to* the Base, and also to give a margin to cover the far-reaching effects of any train running behind its scheduled time. For these reasons it is customary and necessary to deduct 25 per cent. from the total theoretical maximum and the figure 20 thus becomes 15, a maximum which in the case under investigation should never be exceeded.

Of these 15 trains one will be the mail for postal, urgent military and railway services, and for civil traffic generally; one will be a mixed train for civil traffic, railway coal and stores, small military details and detachments and the like; and if supplies have been previously accumulated at the Base, probably two trains will be required daily for military supplies throughout the period of concentration. This leaves 11 trains per diem for troops and transport, and the question now is, will this number satisfy the requirements of the military situation. If the answer is "No," the Terminal Railway is called upon to increase the capacity of the single line by interpolating crossing stations on the long runs or to double the line till the desired limit is arrived at.

Who should pay is always a problem of some difficulty, but it has been satisfactorily solved in the past and will always be so, as long as it is recognized that a perfectly sound scheme of concentration is in the nature of an insurance on the part of Government against the effects of a disastrous war.

As soon as the Terminal Railway and Army Headquarters are in agreement in the matter of the capacity of the line near the Base, the Special Traffic Officer in consultation with the Quartermaster-General's representative will work out a rough scheme and having done so it will be his particular duty to explain it to the Locomotive

Digitized by Google

and Traffic officials of the Terminal Railway, with a view to ascertaining whether sufficient engines and rolling stock exist to carry it to a successful conclusion. No estimate of engines and rolling stock can be made with anything approaching accuracy till the Scheme has been roughed out in such a way that the Terminal Railway can be advised of the maximum number of trains which will be required to run over each of its engine runs daily, and of the composition of those trains.

In any concentration on a large scale it is certain that civil traffic in both passengers and goods on the main lines of advance near the Base must be greatly curtailed partly to make room for troop trains and partly to release engines and rolling stock for the more important work in hand. As years go on and the railway communications of India extend, there is less and less reason to fear any difficulty in accumulating sufficient vehicles to compose the trains and engines to haul them. There is a considerable margin now above actual requirements and with the exception of the Terminal Railway near the Base, it is not likely that civil traffic on Indian Railways will be reduced during the period of concentration.

There is no royal road to the solution of the rolling stock conundrum, it must be worked out according to the requirements of each scheme, but as regards engine power, a rough-and-ready rule may be applied. If one engine is allotted per 70 train miles or per 80 train miles per day, according as the concentration is a long one of several weeks or a short one of a few days, plus an allowance of 15 per cent. for locomotive purposes, the total will be sufficiently accurate for practical purposes; shunting, banking and assisting engines should, of course, be separately estimated for according to the requirements of each scheme.

Rolling Stock can be borrowed by the Terminal Railway from Foreign lines, but it is not desirable to replace deficiencies in engines in this manner, if it can be avoided. Borrowed engines must be sent up, manned by their own crews, who will take some time to learn the rules of a strange road, and they will not work as keenly as if on their home line.

Practically the only other question, which will require careful examination before getting out the detailed scheme, is that of water supply both for engines and for the staff. Engines cannot work at high pressure without good water any more than a man can work without food, and this difficult and technical question must be solved by each Locomotive Superintendent as soon as he is made aware of the rough requirements of each scheme. There are for example, localities through which railways run where good water in large quantities is not obtainable, and this fact will necessitate the main line of advance being carried round by a circuitous route rather than hazard a breakdown owing to a failure of the water supply on the more direct line.

As soon, then, as the Special Traffic Officer has satisfied himself

Digitized by Google

that there will be no difficulty in the matter of engines, rolling stock and water, and leaving for subsequent investigation the actual entrainment and detrainment facilities, the existing inadequacy of which will not be permitted to limit the speed of concentration, he can proceed to draw out the detailed scheme, including as it does the time tables, graphic diagrams, and military documents necessary to explain it to those who will have to put it into operation on the outbreak of war.

First it is essential to have a very clear understanding of the requirements which the timing of each military train must fulfil. It will be necessary to arrange for a long halt of about three hours in every 24 for men and animals to have rest, food and water during a long journey, and certain convenient points will be selected at which supplies can be collected and water and conservancy facilities provided. Short halts of about 30 minutes each are also required every morning and evening for a light meal for the men and for watering animals; if possible these short halts should be arranged for at stations where railway requirements necessitate shunting, changing and watering engines, etc. Then there are certain minimum time allowances which must be given for railway business, *e.g.* 20 minutes for changing engines, 8 minutes for watering one and 15 minutes for two engines, 5 minutes for crossing two trains and 2 minutes halt for trains at all roadside stations; this time for all trains to halt at all stations should be given in the time table, although it is not necessary for a train to be brought to a stand, if the line is clear for it to go through.

Secondly, it should be decided that in the time table, which will be brought into force on the outbreak of war for concentrating an army on the Base, all trains will be run at the same speed with the exception of one mail train daily. The more nearly trains can be run at the same speed, the greater the number that can be put on the time tables and the less confusion there will be owing to slow trains lying side tracked to give way to those timed at a faster speed. In selecting the routes of the main line of advance it is of paramont importance, that, when there is more than one Base, an independent well-defined route should be allotted to each. It will be apparent with a little consideration that if the same line of advance is used for more than one Base a delay in concentration on one Base will affect that on the other, and it is therefore most desirable that the train movements should be separated as far from the Bases as the network of Railways will allow.

But the most important matter in connection with all concentration schemes is the system under which trains are to be grouped. In the past it has been customary to provide for a continuous succession of trains to the Base, running one after the other as close as the capacity of the line will allow, but it has been considered that this arrangement is likely to be unsatisfactory in practice in that an accident will throw back through the whole scheme and lead to great confusion. Accordingly the "Block" System, whereby the Force to be concentrated

Digitized by Google

is divided into groups of convenient size, has been evolved with the object of restricting a breakdown to the group during which it occurs, subsequent groups or "Blocks" being retarded till communication has been restored.

A "Block" is a group of units composing a force, and will be so comprised that it can concentrate on the Base within a given period; a complete infantry division, for example forms a convenient Block.

"Blocks" are arranged in a normal order, which will not be departed from except in emergency; this is a necessary proviso because Railways want to make plans for the return of the empty rolling stock of one "Block" to stations from which the next is to be moved and any ill-considered change in the "Normal" order must increase the already difficult problem to be solved by Railways. If however, a change in the military situation demands it, the preconcerted order of "Blocks" can be altered with far less confusion and disorganization than if the scheme were one of continuous movement.

In arranging the normal order of "Blocks" technical troops will usually be pushed through first, followed by some of the transport and it has been found desirable to commence the first "Block" slowly with a few trains on the first day and gradually working up to full pressure on the 3rd or 4th day, so as to accustom the Railway Staff to the movement.

The accompanying Train Graphic (*Plate* I.) which will be explained later, gives an illustration of the allotment of trains to a Transport Block moving on an imaginary base.

The Special Traffic Officer, remembering all these details, will now proceed to construct the working Time Tables for the use of the railway men who will control the movement. He will in all cases work back from the Base, and as he goes further back to the junctions of the Terminal Railway with foreign lines, it will be necessary for him to get into very close touch with the Traffic officials of those lines in order that the Time Tables may be thoroughly practical. The *Working Time Tables* will be prepared in the form familiar to all railways, and need not be enlarged upon here; the rest of the documents comprising the scheme, however, need some explanation, for it is essential that they shall be drawn out and printed in such a form as will be intelligible to all those who may be called upon to put the scheme into practice.

From the Working Time Table will be prepared an *Abstract* (see next page) giving only such information as is necessary for Staff Officers and Officers Commanding units; it is usual to issue with it a skeleton map of the line or lines of advance, a distinctive colour being used for each, if the Concentration is on more than one Base.

From the Working Time Table will also be drawn out the Train *Graphic* for the use of Military and Railway Staff Officers, and as already stated, a specimen is attached in which a fictitious Base has been assumed for purposes of illustration (*Plate* I.).

Digitized by Google

ABSTRACT TIME TABLE.

Station.	Mail. 1	Mixed. 3	A.	B Supply.	C Supply.	D.	E.	F.	G.	H.	J.	K.	L.	M.	AA.
Lahore ... ... *d*															
Amritsar ... ... *a*															
Amritsar ... ... *d*															
Ludhiana ... ... *a*															
Ludhiana ... ... *d*															
Umballa ... ... *a*															
Umballa ... ... *d*															
Etc.															

Digitized by Google

The marginal notes on the specimen Graphic will explain the conventional signs used thereon, it is only necessary to add a few words on the method of distinguishing between trains. In India the usual procedure is for Railways to allot odd numbers for "up" and even numbers for "down" trains, but for various reasons it has been decided to distinguish between military trains by letters instead of numbers. Accordingly the letters A to M are set apart for trains to the Base and N to Z from the Base; if there happen to be more trains *to* the Base than letters A to M, the extra trains will be lettered AA, BB, CC, etc.; a similar rule is applied to lettering trains *from* the Base.

In addition to the lettering for time-table purposes military numbers are assigned to trains on the Graphic; these military train numbers run consecutively through the Block in the order in which trains are timed to arrive at the Base, and are necessary for the purpose of tracing each train through the various Military Tables and documents (to be detailed hereafter).

As soon as the groups of units composing an army have been allotted to Blocks, the Special Traffic Officer must consider the question of their most convenient order of arrival at railhead. As a general rule it is the distance which trains have to travel which will determine their arrival, for those which start from the most remote localities will necessarily arrive last, unless they are started some time before the conclusion of the previous Block, a procedure not to be recommended for the excellent reason that it swallows up the safety interval, which, as has been explained, is the main principle of the Block System.

The facilities existing at entraining stations form another factor in the calculation; it will rarely be desirable to equip a troop entraining station with platforms in excess of what may be necessary for ordinary civil traffic, and for the movement of troops in peace, and certainly it will never be sound to provide additional platforms for the sole purpose of conveniently forming a Block.

Detraining facilities at the Base Station will also have their influence on the order in which trains are timed to arrive, but the design of the terminal yard is generally worked out so as to give a considerable margin above estimated requirements in order to meet unforeseen delays in movement which are more the rule than the exception in actual practice.

The above are the chief considerations which have to be borne in mind in placing the trains of units in a Block; there are however many other details which the Special Railway Officer will have to remember, and perhaps the most important of these are that good long intervals should be given between the arrival times of trains carrying animal transport or A.T. Carts, and that supply trains are best timed to arrive at railhead during the night so that wagons can be placed in position for unloading at an early hour next morning.

Digitized by Google

PLAN OF MOVEMENT. SCHEDULE. BLOCK _____

Train No.	Unit.	Train of Unit.	Timing.	Entrains at			Halts at Engine Changing and Rest Camp Stations.														Detrains at		Return of Stock.			Utilized for Train.	See Stock Table Page.
				Station.	Day.	H. M.	Day.	Arrival.	Departure.	Day.	Arrival.	Departure.	Day.	Arrival.	Departure.	Day.	Arrival.	Departure.	Day.	Arrival.	Departure.	Day.	H. M.	Timing.	Departure. H. M.	Destination.		

Note.—These columns are for Rest Camp Officers, Loco. Foremen, etc., and in lieu of the Graphic.

Digitized by Google

Assuming that the Working Time Tables and Graphics have been got out, and approved by the various Army and Railway Departments, the next step is for the Special Officers to compile *Concentration Tables* for each Block giving the composition of each train, the unit which will occupy it, and when and where the entrainment will take place.

These Tables together with an *Abstract of Rolling Stock required daily* at each entraining station, are required by the Traffic Managers of each railway involved in the movement in order that they may elaborate their schemes for collecting stock at the proper place and time.

The only other documents relating to the Concentration Scheme are tabulated for the information of the units of the Force and are called *Plans of Movement* (see page 228); they give complete details of the movement of each unit from the starting station to destination.

All these Time Tables, graphics and rolling stock tables are so compiled as to be explanatory the one of the other, and as the same symbols to designate a particular train are used in each document the details can at once be checked from one to another.

Thus the scheme for concentration is prepared in an easily intelligible form for the use of those who will be responsible for its operation on the outbreak of war; no scheme, however, can be expected to succeed unless a special War Staff is organised for the Terminal Railway and each individual member of it well instructed in peace time in his duties during the concentration.

The best way of organizing such a War Staff seems to be that at the Headquarters of the Railway should be located a Concentration Railway Officer, who may well be the officer who has drawn out, or is responsible for the revision of the scheme, and who should be under the direct orders of the Manager or Agent of the line. He should deal personally with all Concentration matters in peace time, and on war being declared should direct the whole movement in consultation with an officer from Army Headquarters, holding the appointment of an A.Q.M.G. With these two should be associated a Senior Supply Officer for the purpose of detailing the allotment of wagons day by day to the stations where supplies are ready to be moved up to the Base. At the Headquarters of the District, on which the Base Station is situated, the District Superintendent of the line will be located, and associated with him should be a *Senior* Railway Concentration Officer detailed by Army Headquarters; under the orders of the District Superintendent, Assistant Superintendents should be told off to the Base and to important halting and entraining stations, and with them again R.C.O.'s detailed by Army Headquarters. This means that there should be a responsible Railway Official at each important point, and at his elbow a selected Military Officer with whom to consult. It has not been found desirable in practice to allow the Officers Commanding units to have

Digitized by Google

direct access to the Subordinate Railway Staff; the subordinate will usually be more influenced by the forcible way demands are made than by a consideration of the resultant effect of carrying them out, and what may be exceedingly convenient and desirable in respect of one solitary train may have a disastrous effect on the whole movement.

It cannot be too strongly insisted that a well-trained and tactful R.C.O. is an imperative necessity at each important entraining and detraining station during a great Military Concentration, but one without training or constitutionally unable to appreciate the Railway point of view is far worse than useless. The Railway Manual (War) summarizes the duties of the R.C.O.'s as follows :—

"(i.). To be the intermediaries between the Army and the technical administration of the Railway.

(ii.). To see that the ordinary working of a railway is carried on in such a manner as to ensure the greatest Military efficiency.

(iii.). To see, on the other hand, that the demands of the Army on the railway, which must always be addressed through the Railway Control Establishment, are, subject to military exigencies, so regulated as not to disorganize the working of the railway system as a whole.

This summary gives a very clear idea of the responsible position of an R.C.O., and it is evident that the third duty is not one which can be intelligently carried out by an officer whose only experience of railway operation is gleaned by travelling as an ordinary passenger from one place to another. It has been the practice of recent years to send some of the students at the Quetta Staff College to a Railway Headquarters for the purpose of giving them some insight into the difficulties of traffic operation, and it would be well if this procedure could be extended to selected Regimental Officers also.

As soon as the Terminal Railway, which is most affected, is put in possession of the details of the scheme, there are many questions which must receive fuller and more careful attention, and it will fall to the lot of the Special Traffic Officer at Railway Headquarters to examine them.

He must decide first of all how the necessary *engines and rolling stock* are to be collected at the right places, or in other words he must get out a definite subsidiary scheme for changing from peace to war conditions and for closing down civil time tables and introducing the Concentration Service on the main lines of advance.

In order that the change may be effected without confusion, as long notice of concentration as possible is desirable; the necessity of this notice will necessarily vary directly as the magnitude of the movement. Not only have engines and rolling stock to be moved up from distant points or possibly borrowed from foreign railways, but station and

Digitized by Google

running staff have also to be collected from areas unaffected in order to strengthen points nearer the Base on the main lines of advance.

All this preparation on the part of the Terminal Railway will take time to carry through, but before war actually breaks out there will, it is thought, be a period of what may be called, "tension" during which the railway will make all preliminary arrangements, so that when the actual warning to concentrate is given, very little will remain to be done. The Special Traffic Officer will in peace time compile detailed instructions for the principal District Superintendents concerned, and everything will be ready for the issue of the Time Tables, Graphics, Concentration Tables, and Plans of Movement.

The accommodation provided for *detrainment* of troops, transport and stores and for the many railway requirements at the Base Station must be investigated and brought thoroughly into line with the scheme. A sketch plan (*Plate* II.) shows what may be considered a convenient arrangement for a Base yard at the railhead of a single line, and would be deemed to provide adequate facilities for the fictitious scheme which has been worked out earlier in this article. It will be particularly observed that the sketch plan allows for an entirely separate yard for military stores, and that in all cases large clear areas are provided in the vicinity of detraining platforms for forming up and for collecting transport without blocking the roads.

The facilities required at *entraining* stations must also be examined, and all preparations made to meet the most difficult case that may occur: there are certain obvious requirements which need not be enlarged upon here and it is only necessary to call attention to one, namely that it is always better to provide such facilities as will enable a whole unit to entrain at one station and will obviate the shunting on of extra vehicles at roadside stations to the train after it has left the starting station. It should be easy to arrange for this even with a long train of 45 four-wheeled vehicles except in the case of supplies, which will take a longer time and greater space in loading; shunting on of supply wagons on the road will be inevitable, but loss of time can be greatly minimized by the intelligent grouping of stations where supplies are to be loaded so that a full train load can be made up from two or three stations daily early in the train's journey.

An endeavour has been made to show how the problem of concentrating troops by rail on a Base of operations is now tackled in India, and it will be as well to briefly recapitulate.

Having first ascertained strategic requirements and the capacity of the Line of Communication by road beyond the Base, test the main line of advance by rail near the Base, and determine the daily maximum number of trains which can be run in practical working on that line.

If Army Headquarters are satisfied with this number, find out from the Terminal Railway whether their engines and rolling stock are adequate to carry out the movement for protracted periods and if not whether they can be supplemented by borrowing from other lines.

Digitized by Google

If the Military situation demands a greater number of trains per day than the existing line can hold, the capacity of the line must be increased by interpolating crossing stations on the longest station-to-station runs, or even by doubling the track.

Having, then, brought Military requirements and Railway facilities into agreement, allot the units of the Force to be concentrated into Blocks of convenient size, work out the detailed Time Tables, Concentration Tables, and Plans of Movement, and issue them to those who must in peace time take such steps as are necessary for the successful carrying out of the scheme on the outbreak of war.

All this would appear to be plain sailing, but in actual fact an enormous amount of weighty argument must be indulged in between Army Headquarters and the various railway administrations before a suitable compromise can be arrived at. If the parties concerned merely sat down and wrote letters about a scheme of concentration the process of evolution would be interminable, but, as has been said, the co-ordination between them has been insured by the appointment of a soldier, with practical railway experience, who devotes his whole time to attaining the object in view, and who by reason of his dual experience is enabled to intelligently explain the views of one party to the other.

Some practical experience of the efficiency of these methods of working out a Concentration Scheme was obtained on the occasion of the assembly and dispersal of troops for the Delhi Durbar in 1911. The conditions, it is true, were somewhat different from the real thing, as the force concentrating on Delhi was not accompanied by the due proportion of transport, and it was therefore not necessary to adopt the Block System of working. The various Military and Railway documents and tables were prepared precisely as they would be in case of war, but, as the civil traffic was not suspended—quite the reverse in fact—and rolling stock had to be economized, the concentration of the force of 45 battalions of infantry, 13 regiments of cavalry and 114 guns occupied as long as seven days in all.

Considering that the railways in the vicinity of Delhi were abnormally congested at the time of the concentration and dispersal of this force, and that of 81 troop trains in and 91 out, only four arrived and two left over an hour late, the scheme may be looked upon as having worked out successfully. As remarked upon by Capt. C. S. M. C. Watson, R.E., Special Traffic Officer in charge, all such schemes, made out long in advance will inevitably undergo small alterations up to the last moment. In this lies one of the chief advantages of the "Block" system, in that changes in one Block can be made without in any way affecting the others.

The Graphic is an illustration of a fictitious scheme, and has been adapted from a similar one used by Capt. Watson in a lecture given in Simla in 1911 on this subject.

Digitized by Google

ELECTRIC LIGHTING FOR MOTOR CARS.

By LIEUT. G. L. HALL, R.E.

THE many obvious advantages of electric over other forms of light for motor vehicles, have been realized since their earliest days, but a large impetus has recently been given to this method of lighting by the perfecting of the metal filament lamp, which, consuming as it does less than one-third of the power required by the older carbon filament type for a given candle-power, is peculiarly valuable where economy of space and a minimum of weight are of primary importance.

Current for the lamps may be supplied either by a battery alone or by the combination of a battery and dynamo. In both cases the secondary type of battery is the only one which is suitable. The employment of a battery alone has been the general practice until recently. In such cases it has been usual to employ electric lamps only for the side and tail lights, whose aggregate candle-power is small. If, however, it is desired to supersede the ordinary acetylene head lights, the use of a battery alone becomes unsatisfactory. About 10 candle-power is all that is required for side and tail lamps together, but to provide an efficient driving light and to replace the ordinarily very powerful acetylene lamps necessitates very much more. In fact, a pair of 40 candle-power bulbs in suitable reflectors may be taken as a reasonable equipment for cars of moderate power. A battery which could perform this total duty without very frequent re-charging would be extremely bulky and expensive. If, however, a dynamo can be installed on the car, which will perpetually keep the battery fully charged, a much smaller one will suffice, and the plant will be self-contained; a very great advantage, especially in districts where the charging of batteries is uncertain and expensive.

Many dynamos for this purpose are now on the market, which are designed to be fitted to the car and to be driven by the engine. It is the object of this article to explain the electrical difficulties which exist in the practical realization of such an arrangement, and to outline the manner in which these difficulties are in certain cases overcome.

The first point which naturally suggests itself is this. Electric lamps are designed to work at a certain definite pressure (expressed in volts), and any considerable variation in this pressure will result in

Digitized by Google

inadequate light if the pressure is too low, and in the destruction of the lamp filament if it is too high. On the other hand, the pressure at which the ordinary dynamo works varies under ordinary conditions directly as the speed at which it runs. The problem then is to arrange for a dynamo, which is driven by an engine whose speed varies over a wide range, to give a pressure which shall only vary within the small limits permissible at the lamp terminals. The case is, in fact, very similar to that of ordinary railway vehicle lighting, and as will be seen later is solved by some makers in very much the same way. Certain difficulties however arise in the case of road vehicles which are not experienced in train lighting, partly because of the lack of that skilled attention which the latter receives, and partly owing to the rougher usage to which all parts of a road vehicle are subjected. On the other hand, the added complication due to the frequent reversal of the direction of running in the case of railway vehicles is absent in connection with a motor car, whose engine, at least, runs always in the same direction.

Batteries will be necessary in conjunction with the dynamo, if only to ensure continuity of light when the car is at rest, or is travelling at low speeds; under which circumstances the dynamo will not be running fast enough to generate sufficient pressure to feed the lamps. In practice, the ideal which is sought is to maintain the dynamo pressure approximately constant at car speeds of from 10 to 15 miles per hour upwards.

A diagram of the general arrangement is given in *Fig.* 1 which shows the generator connected to both battery and lamps. When the pressure of the dynamo exceeds that of the battery a charging

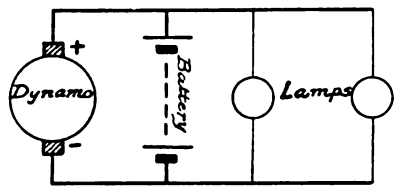


FIG. 1.—*General arrangement of Car-Lighting Equipment.*

current will flow from the machine to the battery and lamps. Whenever the speed of the generator drops so much that its pressure is below that of the battery, the latter will take up the load. Under these circumstances a current will naturally tend to flow from the battery through the dynamo and to run the latter as a motor. This may be obviated (as in the case of central station batteries) by an automatic cut-out device, which allows a current to pass through it in one direction only, *i.e.* from the dynamo to the battery, and breaks the circuit between them in the event of any tendency towards a reversal of current caused by the battery pressure exceeding that of the dynamo. Such systems as do not employ this reverse

Digitized by Google

current cut-out in one form or another, either employ a centrifugal speed-operated switch or arrange that the power taken from the battery to motor the dynamo shall be negligible.

There are in practice three distinct ways in which a constant pressure at the dynamo terminals can be secured, and examples of them all can be found on the market. These systems are—(1) Variable speed dynamos whose pressure and output are kept constant by purely electrical devices; (2) dynamos driven by a variable speed engine through a form of centrifugal clutch, which never allows the speed of the machine to rise above a definite value; and (3) variable speed dynamos whose pressure is kept constant by a combination of electrical and mechanical devices. Some examples of these will be taken and their principle explained as far as can be done without going too far into technical details.

1. Electrically Regulated Dynamos.

Electric regulation can be accomplished in many different ways, and a large number of distinct types are at present on the market. Of these, the simplest, though not necessarily the most efficient, are machines of the constant field type; that is machines in which the primary strength of the magnetic field is independent of the pressure at the dynamo brushes. This may be accomplished either by separately exciting the field coils by means of a battery used solely for this purpose—a fairly obvious drawback—or by using permanent magnets to supply the magnetic field in which the armature rotates. Examples of this latter class are found in the *Lodge* and the C. Jarrott and Letts *C. J. L. Magnetolite* machines. In these systems steel permanent magnets are used of very much the same type as those employed for ordinary ignition magnetos. The principle on which they maintain a fairly constant pressure and output is shortly as follows:—

As soon as the speed of the dynamo reaches a certain value a charging current will flow through the battery, rising rapidly in value until a point is reached when the demagnetizing effect of this current flowing through the armature so weakens the main magnetic field that the pressure and charging current remain approximately constant however much the speed of the machine increases. This effect, technically known as armature reaction, is the underlying principle of all electrically regulated variable speed machines. It is caused by the magnetic field set up by the passage of the current through the windings on the dynamo armature, part of which magnetic field directly opposes the main field (produced in this case by the permanent magnets) and therefore weakens it. The natural result of this reactive tendency of the armature current is that the dynamo now generates a lower pressure than it would have done had the main field remained at its original strength. There is, in fact, a state

Digitized by Google

of war between (1) the natural tendency of the dynamo to generate a higher pressure as its speed increases; and (2) the increased armature reaction due to the heavier current which this higher pressure naturally implies. The practical result is, in short, that there is a limit to the amount of current which the machine will send through a given external resistance.

A practical difficulty in connection with all permanent magnet machines is the possibility of the weakening or destruction of their magnetism. Apart from the effect of the vibration of the car, the de-magnetizing effect of the armature current would appear to be necessarily to some extent permanent and cumulative, so weakening the magnets as to render them, in time, useless. The use of wound electro-magnets is not, of course, open to this criticism.

Both the *Lodge* and *C.J.L.* systems employ reverse-current cut-outs, which keep the circuit open until the dynamo pressure exceeds that of the battery. The former is designed to run at 6 volts and the latter at either 8 or 12.

The *Bleriot* dynamo is of the electro-magnet type, and the field is compound wound, the windings being arranged differentially. That is to say, the magnetic field in which the armature revolves is produced by two distinct windings, one of which is in series with the load, the other being connected across the dynamo terminals and so arranged that the magnetic field produced by it shall oppose that produced by the series winding. A diagram of the arrangement is given in *Fig.* 2. The shunt winding may be regarded as the normal

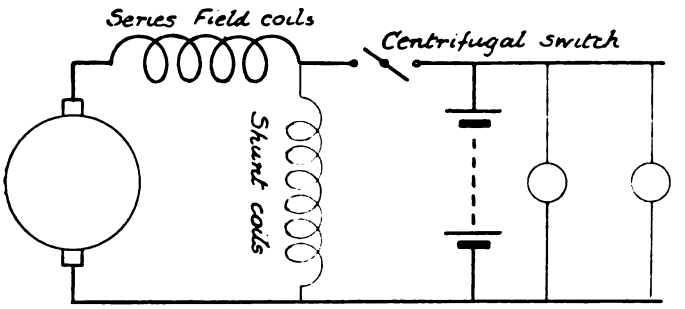


FIG. 2.—*The Bleriot system.*

exciting coil, the series winding being inoperative until the generator begins to send out a charging current. As soon as the necessary speed is reached the centrifugal switch closes and the dynamo is automatically connected in series with the battery. A current will now flow through the series coil, and since this is wound to oppose the shunt coil, the main field of the generator will be weakened. The heavier is the current through this series coil, the more marked is the de-magnetizing effect, with the result that a large increase in speed will only mean a comparatively small rise in pressure and the

Digitized by Google

charging current will be kept within reasonable limits. It will be noticed in *Fig.* 2 that the machine is connected in "long shunt"; that is to say, the current from the positive brush of the dynamo passes through the series windings before it reaches the shunt coil. This implies that a much greater voltage variation can be allowed at the brushes than is experienced at the dynamo terminals, and consequently that a better compensating effect is produced by the series winding than would be the case if the shunt coils were connected directly across the brushes. The machine must never be allowed to run the lamps unless the battery is also connected in. This is important, not only from the point of view of efficient voltage regulation, but also because of the danger of a reversal of the polarity of the dynamo which might occur should the shunt coil not be fully excited. This system is designed to work at 12 volts.

Remarkably close voltage regulation and steady lamp current are obtained in the case of the *C.A.V.* dynamo, manufactured by C. A. Vandervell & Co., which is somewhat similar in principle to the well-known Rosenberg train-lighting machine.

The general arrangement of the dynamo is shown in *Fig.* 3. It is a

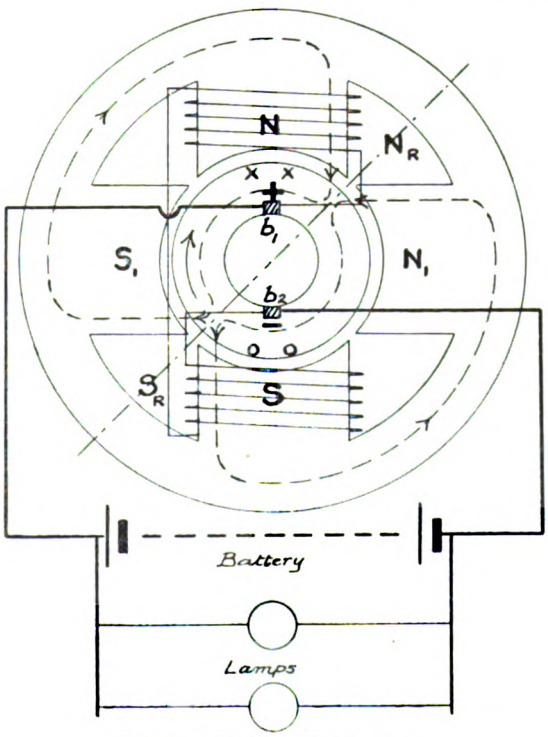


FIG. 3.—*The C.A.V. Dynamo.*

2-pole machine, but is constructed with two sets of pole pieces NS and N_1S_1, at right angles to each other. The former pair are excited

Digitized by Google

by windings connected across the brushes $b_1 b_2$ and also to the battery terminals. The unwound poles $N_1 S_1$ may be regarded as the two ordinary poles of the machine, and the brushes are set in the neutral axis* with respect to these poles, that is to say at right angles to the neutral axis of the wound poles NS. At the moment of starting, the poles NS are fully excited by the battery, and as the armature begins to revolve, its windings cut the magnetic flux flowing across from N to S. Now since the brushes are set at right angles to the neutral axis of these wound poles, there will, for the moment, be no potential difference between them, but a comparatively heavy local current will flow in the windings which are, in turn, short-circuited by the brushes. The reason is, that, during this momentary period of short-circuit, the windings in question are not in any neutral axis (as in the case of the ordinary dynamos) but are in the working axis of the poles NS and are therefore subject to the maximum inductive effect of this field. The position of these windings is shown at X, O in *Fig.* 3.

This short-circuit current at once begins to cause re-active effects. A secondary magnetic field will be produced round the windings in which this short-circuit current is flowing, which will cause a magnetic flux at right angles to that produced by the wound poles NS, namely in the direction $N_1 S_1$, the strength of this latter flux being materially increased by the presence of the unwound pole pieces. It is the resultant of these two fluxes which constitutes the working magnetic field, and causes a difference of potential between the brushes. As the speed of the machine rises, and the pressure at the brushes overcomes that of the battery, a charging current will flow to the latter. This charging current, flowing as it does throughout the whole armature, and not being confined to the few coils X, O (as was the original short-circuit current) will in its turn set up a magnetic field directly opposing the flux from the wound poles NS, on which flux, it will be remembered, the whole excitation of the machine depends. The result will be, as in all these electrically regulated machines, that the de-magnetizing effect of the armature current will oppose the natural tendency of the pressure to rise with the speed, and furthermore that the current cannot possibly exceed a certain maximum value, which depends on the ratio of the field and armature ampere turns. When the current through the armature reaches such a value that the flux in the armature along the axis $b_1 b_2$ is equal and opposite to the primary flux NS, then this limiting value is reached. This will be obvious, since if the flux NS is destroyed, the action of the machine ceases. The underlying principle is, in fact, the differential action of two nearly equal forces. Suppose that, with the normal armature current flowing, the flux NS is 10 per cent. stronger

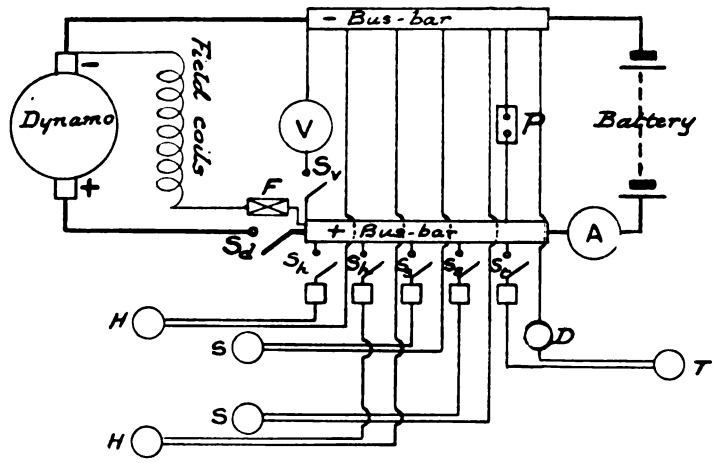
* That is to say, the armature coils which are for the moment connected to the brushes by way of the commutator are lying in the neutral axis with respect to $N_1 S_1$.

Digitized by Google

than the opposing armature flux along the same axis. The current under these circumstances cannot possibly rise more than 10 per cent. above its normal value, however much the speed rises, since an increase in current value of 10 per cent. will imply a corresponding increase of 10 per cent. in the armature flux (or approximately so provided that the iron is not saturated) and the two fluxes will now balance, and the action of the machine will cease.

The battery must be kept connected to the brushes whenever the generator is in use, if only in order that the shunt windings may always be fully excited. The result of this is that the battery will motor the armature whenever its pressure exceeds that of the dynamo. This is arranged for by the provision of a free-wheel roller clutch which will allow the armature to overrun the driving pulley at low speeds. The system is designed to work at 4, 6 and 12 volts.

Fig. 4 shows the practical arrangement of the various circuits on the car, and may be taken as typical of these installations. The



H. H—Headlamps.
S. S.—Sidelamps.
T —Tail lamp.
D —Tell-tale lamp (in series with T).
A —Battery ammeter.
V —Bus-bar voltmeter.
P —Plug for inspection lamp.

S_h—Headlamp switches.
S_s—Sidelamp ,,
S_t—Tail lamp switch.
S_v—Voltmeter ,,
S_d—Dynamo ,,
F —Fuse in Dynamo Field circuit.

FIG. 4.—*Wiring diagram for C.A.V. system.*

bus-bars, switches, instruments, etc., are contained in a small switch-board which is mounted on the dash-board and is under the immediate control of the driver. The dynamo may be arranged in any convenient position; it is frequently placed under the bonnet, and is generally belt driven. The battery should be mounted in such a way as to be readily accessible, as, although there will be no necessity to remove it for re-charging, it should nevertheless be frequently examined and periodically replenished with electrolyte to

Digitized by Google

make up losses from evaporation, etc. A word of warning in this connection may not be out of place. Many makers of these lighting sets are apt to give the impression that the use of a charging dynamo on the cars renders any attention to the battery superfluous. One maker goes so far as to say that "it requires practically no attention." It is almost unnecessary to point out the danger of this doctrine, and it may, in practice, be taken as axiomatic that the life of any secondary battery will vary directly as the amount of careful attention which it receives.

The *Trier and Martin* machine is another which gives extremely good regulation over a wide range of speed. It is very similar in principle to the Leitner train-lighting dynamo. A diagram of this machine is given in *Fig.* 5. It will be seen that, although the

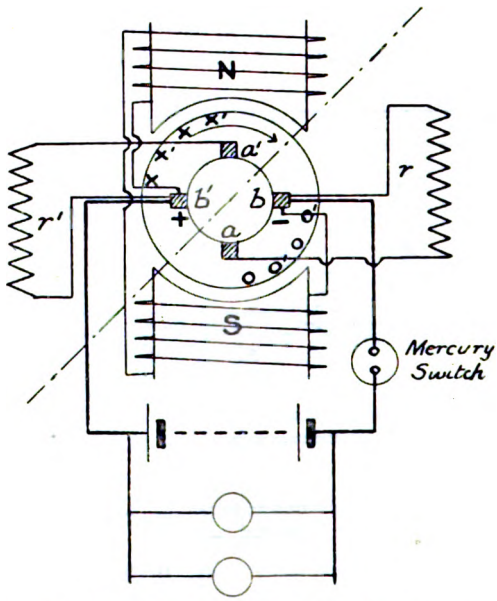


FIG. 5.—*The Trier and Martin Dynamo.*

dynamo is a two-pole machine, it is provided with four brushes, the intermediate ones aa' being set at right angles to the ordinary ones bb' ; ab and $a'b'$ are respectively connected through the resistances r and r'. The magnetic field in which the armature revolves is produced by an ordinary shunt winding, its axis lying along NS.

The rotation of the armature in the field NS causes, in the ordinary way, a difference of potential between b and b', b being the negative and b' the positive brushes respectively. It will be noticed that with an undistorted field (the machine being on open circuit) the brushes a and a' are at equal potentials.

Under these circumstances a current will flow from b', r', a',

Digitized by Google

armature coils $x'o'$, back to b', and at the same time from a, r, b, armature coils xo, back to a. The magnetic effect of these currents will be to assist the shunt coils and to *strengthen* the main field, the flux density being therefore a maximum when the dynamo is on open circuit.

Directly, however, the machine is put to work on closed circuit, armature reaction, as usual, distorts the main field and lowers the potential difference between $b'a'$ and ab. The current flowing between the interconnected brushes is consequently weakened and the strength of the main field falls.

A few moments' study of *Fig.* 5 will show that, when this distortion has reached 45° (as indicated by the chain-dotted line), $b'a'$ and ab will be at equal potentials respectively. No current will therefore flow between them and the main flux will be again reduced in strength. A further distortion will cause a current to flow in the *reverse* direction through r and r', the brush a' now having a more positive tendency than b', and therefore also relieving the latter of a portion of the main current. This reverse current will naturally still further weaken the main flux.

The result, then, of the current through the resistances rr' and through the armature coils concerned—varying as it does from a maximum in one direction through zero to a maximum in the other direction—will be to continually weaken the main flux as the speed and output of the machine rise, thus keeping the E.M.F. and lamp current very nearly constant over a wide range of speed.

An automatic cut-out is fitted in this system of the centrifugal mercury type and is designed to put the dynamo in circuit at a predetermined speed. The standard pressures used are 8 and 12 volts.

Sparkless commutation is no doubt more easily obtained in this type than in the *C.A.V.* at the expense, however, of an extra pair of brushes and a somewhat more complicated design.

2. Mechanically Regulated Dynamos.

Mechanical regulation pure and simple may be considered as falling under one of two heads, firstly systems which depend on constant torque and secondly those which depend on constant speed. Those who have studied train-lighting systems are familiar with the constant torque principle in the well-known Stone machine, where the dynamo is driven by a belt which is allowed to slip when the *output* of the dynamo reaches its predetermined maximum. That is to say, the belt will not communicate more than a certain definite torque to the dynamo pulley. For many reasons such an arrangement would hardly be suited to the case of road vehicles, and manufacturers of purely mechanically regulated machines incline more to the constant speed principle.

Digitized by Google

Of these the *Lucas* system is a good example. The connection between the dynamo pulley and the armature shaft is made by a coned clutch, the latter being keyed to the shaft on which the pulley is free to revolve. At all speeds up to the maximum for which the dynamo is designed, the clutch is held in by springs and the armature is therefore driven by the pulley. The arrangement is so far very similar to the ordinary cone transmission clutch between engine and gear-box. At the maximum speed allowed, the clutch is automatically slipped by the action of a centrifugal governor contained therein which acts against the clutch springs. The dynamo will now continue to revolve at a uniform rate of speed.

3. DYNAMOS BOTH ELECTRICALLY AND MECHANICALLY REGULATED.

Of the systems which employ a combination of electrical and mechanical regulation, few are of much practical value for motor-car purposes. It is not proposed to discuss any in detail, but merely to outline a few of the methods which have been employed.

A common device is the use of a field regulator, by means of which the current through the field windings is automatically varied with the speed of the machine. This arrangement consists essentially of a resistance in series with the dynamo field windings, this resistance being automatically varied by some form of centrifugal governor. The system is simple and practical, but some difficulty seems to be experienced in making the mechanism strong and simple enough for working conditions on the road.

Other systems of this class generally rely either on automatically moved brushes—which is hardly compatible with sparkless running—or else on reducing the number of lines of magnetic force cut by the armature as the speed rises. This is done in one type by varying the air gap between the armature and the pole pieces, and in another by moving the armature axially, thereby in effect reducing the length of the pole pieces. The controlling mechanism in both cases consists of the usual centrifugal governor.

The relative merits of mechanical and electrical regulation may be fairly left to individual decision. At the present time electrically regulated machines appear to be more popular for road vehicles, while, at any rate in this country, mechanical control is more extensively employed for train lighting.

Digitized by Google

SYNCHRONIZATION OF CLOCKS AND THE IMPORTANCE OF CORRECT TIME.

By MAJOR W. A. J. O'MEARA, C.M.G., LATE R.E.

"Our whole terrestrial being is based on Time, and built on Time; it is wholly a movement, a time-impulse; Time is the author of it, the material of it."—*Carlyle.*

INTRODUCTION.

THE decision of the Executive Committee of the British Science Guild to have a paper read before the Guild on the question of the "Synchronization of Clocks and the Importance of Correct Time" is, in itself, a sufficient indication that the subject is well worthy of consideration. Apart from that fact, however, little thought is required to determine that the recognition of the value of adhering to correct time is not restricted to scientists, but that such recognition is shared nowadays, to a very considerable extent, by the public generally.

I have thought that it would not be uninteresting to outline the more important stages which have led up to the present extensive use of approximately correct time.

The importance of time seems to have been recognized by ancient peoples, for it is understood that the obelisk of El Karnak, a monument to the great Queen Hatshefin (XVIII. Dynasty—circa 1,700 B.C.) was utilized as a gnomon, whose shadow was doubtless conveniently used to indicate the approximate time of day. Yet the earliest actual written reference to time appears to be in the seventh chapter of the book of Job, which contains the following words :—

> "As a servant that earnestly desireth the shadow
> And as an hireling that looketh for his wages."

These words (read with reference to the preceding and succeeding verses) apparently relate to the measurement of time by the length of a shadow.

SUNDIALS.

The earliest form of sundial dates from about 540 B.C. About 340 B.C., a Chaldean astronomer, Berossus, appears to have effected an improvement: he utilized the shadow of a bead upon a dial, upon which curvilinear lines were depicted to indicate the hours. Of course, the hours as indicated by this primitive instrument would be

Digitized by Google

of unequal length, but in equatorial latitudes the inequalities would not be so marked as in this country. So far as can be traced, the earliest public Time Service was given by a sundial which was captured from the Samnites by Papirius Cursor, and which was publicly set up in Rome about the year 290 B.C. It may be thought by some that this sundial was exhibited merely on account of its interest as a war trophy, but judging from references to it, it appears to have been regarded as a public time register. It was certainly not constructed for the latitude of Rome, but the importance of the accuracy of the readings cannot at that epoch have caused any serious inconvenience in connection with the business and domestic life of the city. Even in these more enlightened days there are still people who buy sundials in curiosity shops and set them up in their grounds without enquiring into the question of their suitability for the *locus in quo*. It was not until 164 B.C. that the Romans made a sundial suitable for their own latitude.

CLEPSYDRÆ.

After this time it seems to have become apparent that the Clepsydra then utilized for timing speeches in various assemblies could be graduated so as to indicate divisions of time, and the first water clock, which was in all probability calibrated by comparison with a sundial, was constructed in 135 B.C., and this device, together with sand clocks and other devices, heralds the advent of portable timekeeping *machines*. However, notwithstanding its imperfections the sundial has existed through many centuries, and one form known as "the meridian dial" is still in use. This sundial serves to indicate solar noon, and provides a suitable means for checking clocks in localities where the telegraph is not available for sending time signals. The increasing desire for greater accuracy in timekeeping is shown in the improvements which have been effected in even this, the earliest form of timekeeper. The latest form of a sun clock is that recently introduced by Mr. Steward, of the Strand, viz. : the Ferguson Solar Chronometer. The instrument is of a universal type, that is to say, it is suitable for use in any locality ; and it will enable the local time or the standard time of any country to be read without computation or reference to correction tables, the sun's apparent time being automatically corrected so that the shadow on the dial indicates true "clock" time. Incidentally the instrument may also be used as an astronomical compass to ascertain the true North as distinguished from the magnetic North.

Returning now to the period of portable time machines, particularly to the Clepsydra, it must have become apparent to the users that water clocks did not admit of equal divisions on the scale or dial, because the water would not run out with a uniform velocity. This

Digitized by Google

difficulty was surmounted later by using a syphon carried on a float so that the "head" of water remained constant. This improvement is generally attributed to Ctesebius, of Alexandria, who lived about 150 B.C. As soon as it was discovered that a column of dry sand, whatever its height, will pass through a minute hole with absolutely uniform velocity—if the angle at the waist of a sand-glass be made to conform to the natural angle of repose of the sand, it naturally followed that the sand-glass displaced other forms of portable time-keeping machines.

The several different methods by which time is reckoned—for instance, Solar Time, Mean Solar Time, Sidereal Time, and Local Time, are familiar to us. The march of civilization, including the advent of railways and improved and speedy methods of intercommunication, however, has practically abolished the observance of Local Time and we now have the world divided into Time Zones, in which the time on one meridian, generally reckoned as an integral number of hours from Greenwich, is adopted as *Standard Time* for that zone. It appears to me that the use of the term "Zone" in this connection is hardly correct, and that it would be more correct in the nature of things to refer to the area concerned, as a "Lune."

Greenwich Mean Time.

The Greenwich meridian appears to have been adopted early in the XIXth century as the prime meridian for all civilized countries, and Greenwich Mean Time is now the standard for Great Britain, France, Belgium, Holland, and Spain. Mid-European Time (the next zone or lune meridian, 15° East of Greenwich) one hour fast of Greenwich, is adopted for Germany, Austria-Hungary, Sweden, Norway, Denmark, Switzerland, Italy, etc. In some places Local Time is still observed, *e.g.* in Russia, where St. Petersburg time is in use (1 min. 13 sec. fast of East European standard time) and in Ireland, where for some peculiar reason Dublin time is employed (25 min. slow of G.M.T.). Recently, however, some of the Irish Chambers of Commerce have expressed a wish to adopt Greenwich Time.

Time Machines.

It is generally believed that clocks driven by weights were invented either by Pacificus, Archdeacon of Verona, in the IXth century, or by Gerbert, Archbishop of Magdeburg, in A.D. 996. It is recorded that in 809 Haroun Al Raschid made a present to Charlemagne of a curious clock which struck the hours by letting little metal balls fall on a bell. This, however, is thought to have been one of the Clepsydræ family. We then find that in the XIIth century a clock impelled by weights and wheels was sent by the Sultan of Egypt to the Emperor

Digitized by Google

Frederick II. Later on, in 1292, there is a reference to a clock in Canterbury Cathedral costing £30. Then there followed a clock made by Henry de Vick for Charles V. in 1370, which had a balance, and so on; one can trace the development of the art of watch and clock making by fairly easy stages down to the present time, when time-keeping devices are so numerous and so cheap that there are few persons who do not possess some article indicating the hour of day. The modern clocks, too, are constructed with such skill, and are of such excellence in timekeeping, that, provided they be properly adjusted and periodically corrected, they can be implicitly relied on.

SYNCHRONIZATION.

I now come to the principal part of my paper. The Executive Committee of the British Science Guild, in their first report, referred to the question of clock synchronization, and pointed out that the observance of uniformly correct time was a *sine quâ non* for the proper conduct of business. I may say that in the Post Office this fact has always been recognized, for in the first place many operations in connection with the despatch and reception of mails have to be conducted in different departments, all tending towards one end, that is the catching of trains at definite times. While the increase in rapidity of communication by means of railways demanded certain exactitude of timekeeping, the introduction of the telegraph called for even a finer degree of accuracy, wherefore in Telegraph Offices it is essential that there should be absolute uniformity of time between the various sections of an office where the transmission of a telegram is concerned. A telegram in the course of transmission from the town in which it originates to the town in which it is finally delivered, passes through a succession of processes, in each of which it is carefully timed, primarily to ensure that it shall take its proper place amongst the others with which it may converge upon a particular route, and also to ensure that as little time as possible may be lost between the several operations necessary, from the time it is handed over the Post Office counter to the time when its text is delivered to the recipient. An idea of the necessity for *strict accuracy* in the timing of telegrams may readily be obtained when it is considered how many business transactions, notably those relating to stock and share dealing, produce, ship brokerage, etc., depend upon the time at which a telegram is handed in to the Post Office for transmission. The importance of such accuracy in connection with "betting" telegrams will also be remembered. As is well known, the time of "handing in" a betting telegram altogether decides whether the bettor expressed his opinion as to the relative merits of the contestants, or in other words "backed his fancy," before the struggle for

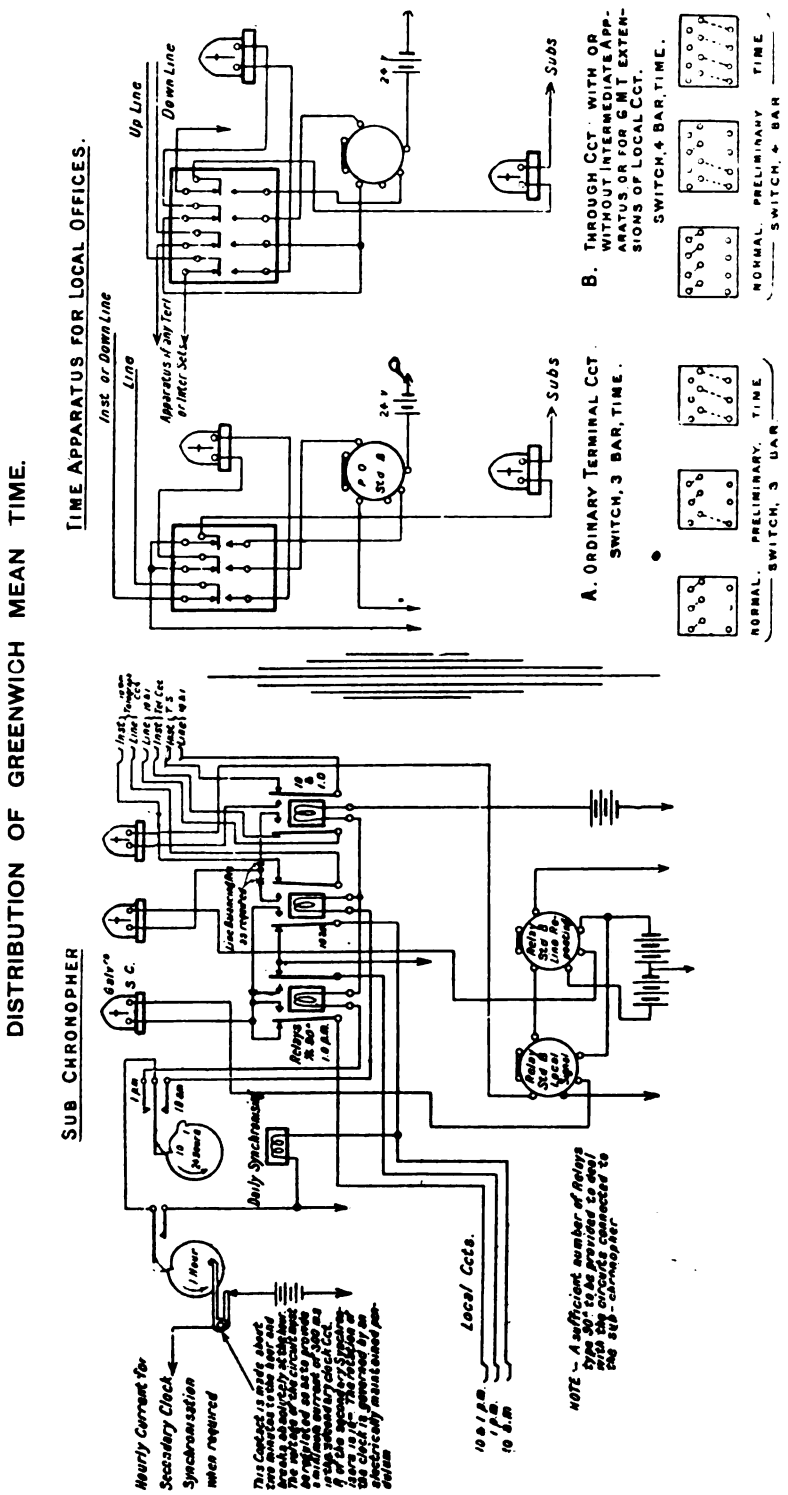
Digitized by Google

supremacy commenced. It is, therefore, a matter for congratulation that the accurate timing of telegrams *conduces* to honesty in transactions of this character. Such accuracy, in itself, is not, of course, an effective means of preventing fraud. I remember an incident which occurred in my own experience. In my young days I had to visit a certain place at which racing stables were situated, and in this connection I learned of an extensive scheme of fraud which was being perpetrated on ignorant yokels. In a public house, arrangements were made for a clock to be kept behind time, and betting was continued right up to the advertised starting time of races, as shown by that clock. In adjacent premises an accomplice received telegrams announcing the results of the races, and he, by means of a code of signals, communicated the results to the persons offering the bets; these individuals were thus in possession of results whilst still offering bets on them. Such frauds as that referred to can readily be made impossible by the adoption of regulations designed to ensure that clocks in public places are maintained so that they register standard time.

Distribution of Greenwich Mean Time.

Returning to the matter of correct time in the Post Office, I may perhaps with advantage explain how in the past this has been achieved. Since the early days (1852) of the Telegraph Companies, the Post Office has received an hourly signal transmitted automatically from the Mean Solar Clock at Greenwich Observatory, and at 10 o'clock every morning the signal has been re-transmitted by telegraph to every telegraph office throughout the Kingdom, thus enabling all Post Office clocks to be re-set by hand. The telegraph wires were soon found to be a convenient means whereby watch and clockmakers could be served with a daily time signal, and as the manual transmission of the time was not sufficiently accurate to meet their requirements, which comprised the determination of the rates of marine chronometers and the checking of their own regulators, something in the nature of automatic transmission became necessary. To achieve this object, an instrument, called the Chronofer, was designed by Mr. C. F. Varley, about 1865. This device was really of the nature of a multiple switch whereby wires radiating from the London Office in Telegraph Street to various provincial towns were connected either to their telegraph instruments, or bunched together in groups on relays, which were operated by the receipt of the signal from the Observatory. The operation of the multiple switch was effected by means of a spring motor, which, from about two minutes to 10 o'clock to two minutes after, caused the switch to change over. This spring motor was controlled by an electrical contact on a clock. Hand-operated switches were used to extend the London wire by means of

Digitized by Google


DISTRIBUTION OF GREENWICH MEAN TIME.
SUB CHRONOPHER
TIME APPARATUS FOR LOCAL OFFICES.
Up Line
Down Line
Inst. or Down Line
Line
Apparatus of Jahr Teri or Inter Sets
24 V
Subs
A. ORDINARY TERMINAL CCT SWITCH, 3 BAR, TIME.
B. THROUGH CCT. WITH OR WITHOUT INTERMEDIATE APPARATUS, OR FOR G.M.T. EXTENSIONS OF LOCAL CCT. SWITCH, 4 BAR, TIME.
NORMAL. PRELIMINARY. TIME. SWITCH, 3 BAR
NORMAL. PRELIMINARY. TIME. SWITCH, 4 BAR
Hourly Current for Secondary Clock Synchronisation when required
Local Cctts.
Daily Synchronising
Relays
Relay Std 8 Local Signal
Relay Std 8 Line Re-inforcing
NOTE – A sufficient number of Relays type 30 to be provided to deal with the circuits connected to the sub-chronopher.

Digitized by Google

a local wire connected between the Post Office, and the premises of those who desired to use the signal. I may add that the Time Signal from the Observatory was made to synchronize automatically the clock controlling the Chronofer. I propose to deal with the question of automatic synchronization presently. It is interesting to know that the Chronofer as installed in those early days is still in existence and is still doing useful service. However, notwithstanding amplifications and additions which have been made from time to time to meet the growing needs of the service, the growth has of recent years become so great that the Chronofer has become much overloaded. The temporary disturbance of the telegraph wires has also resulted in such inconvenience to telegraph traffic that it has now become necessary to devise a new method for the distribution of time, and to replace the present Chronofer by apparatus of more modern and efficient design.

New Distribution System.

The Hourly Signal will continue to be transmitted from the Mean Solar Clock at Greenwich Observatory to the Central Telegraph Office in London, where it will be received upon a main relay forming part of the new Chronofer apparatus. The local side of this main relay operates other relays, which will transmit the hourly signal to London renters, and will ring bells, etc., fixed in various administrative and operating departments of the group of buildings associated with the G.P.O. headquarters.

Certain main distribution circuits, normally used for telegraph purposes between London and provincial centres, will be connected to the tongues of groups of switching relays, which normally retain these circuits in connection with their telegraph apparatus, but which, when operated by control circuits from a special electrical clock, will transfer the telegraph circuits from the telegraph apparatus and bunch them on the tongue of a transmitting relay, so that a positive current which forms a preliminary or warning signal, will be sent out on all distribution lines. On the receipt of the Greenwich signal, the operation of the main relay will cause the transmitting relay to reverse the current on the lines momentarily, the reversal constituting the distributed time signal. At certain provincial offices similar apparatus, but on a smaller scale, will be installed for secondary distribution over other circuits radiating therefrom to individual offices, wherein hand-operated switches as before will control the arrangement of the local circuits for transmitting the signal to renters.

Special switching devices will be introduced in the new Chronofer to enable certain Admiralty stations to continue to send reporting signals from their standard clocks (in one case from a time ball),

Digitized by Google

which signals will follow one another in succession over a second wire from London to the Observatory so as to enable the Astronomer Royal to check the performance of the clocks. Distribution to the provinces will take place at 10 and 1 o'clock, and at provincial sub-chronofer stations the switching relays will be joined in groups for the 10 o'clock or 1 o'clock signal or for both signals, according to the service required in any particular town. The controlling clocks are set so as to operate the switching relays from one minute before to one minute after the hours named. This scheme is of course extremely elastic, and will enable growth to take place unhampered by considerations regarding the use of long and expensive telegraph wires. I may say that instead of having upwards of 200 such circuits radiating from London there will be only about 20.

SYNCHRONIZATION METHODS.

(*a*). *Signals.*

Having briefly, but I hope adequately, covered the historical side of the subject, and having endeavoured to show how correct time is obtained and distributed over the country by means of the facilities which are afforded by the vast network of telegraph wires which the Post Office has available for the purpose, I now propose to indicate how and in what manner the knowledge thus distributed is utilized. To do so I must go back some few years to the early attempts which were made to correct clocks and the means generally adopted for that purpose. One of the methods earliest in use was to make the Time Signal operate a visual or audible signal, and I may say that in many cases that practice still obtains. In certain instances it is difficult to see the reason for the retention of such palpably absurd methods, whilst in other cases very good reasons exist, as I propose to explain presently. But first of all I may mention that watch and clock makers who deal with chronometers, and what may be called precision timepieces, *i.e.* timepieces requiring to be transported in surveying operations or for navigating purposes, do not, as a rule, use the Time Signal for the physical correction of their regulator clock or the timepieces under test, but as a means whereby their daily error or "rate" may be ascertained. It will be readily understood that the regulation of chronometers to anything beyond a close approximation to correct time would be a very lengthy process, if not, indeed, a practical impossibility, but if the rate be determined and found constant, and if recorded so as to be available when reference to the timepiece is necessary, the ultimate result will be as good as if the instrument was absolutely correct. For the determination of the clock error nothing can be better than a single stroke on a gong, or some such audible signal. I may here mention that the firing of

Digitized by Google

a gun as is customary in a good many places, is useful as an audible signal only for places in close proximity to the gun, owing to the relatively small velocity at which sound travels. However, the public probably find the announcement that the hour is approximately 1 o'clock (the usual time for gun fire) convenient.

(*b*). *Visual and Audible Signals.*

For exact work the gun fire should be placed in the category of visual signals, for it is the flash that should be noted. It is astonishing how little real consideration is given to the question of the relative values of audible and visual signals. I may quote an instance of an important city in the North, where a great public clock, which, I believe, is the standard for the city, is corrected by hand and therefore may sometimes be appreciably out of time; and this clock is provided with a bell upon which the hours are struck, and the 1 o'clock stroke, whilst prepared for by the mechanism of the clock, is released by the 1 o'clock Greenwich signal, quite regardless of the fact that, apart from the mechanical lag in the striking gear, the sound of the bell must take an appreciable time to reach the outskirts of the city. Quite considerable expenditure must have been incurred in providing the special mechanism involved, and a comparatively large sum is paid annually for the signal, whereas, for a much smaller capital and annual expenditure, the clock itself might have been automatically synchronized and the bells left to take care of themselves, as has recently been done at Aberdeen Town Hall, where the synchronizing gear is so arranged that *all* the hours are struck exactly at the right time. I learn that owing to the peculiar system adopted in the former case, the 1 p.m. stroke has been heard whilst the clock was already engaged in chiming the quarters!

Coming now to the visual signals, the most important in this class is, of course the Time Ball, and many of these are still in use. They are, in fact, the standard means for observatories to announce a certain hour, usually 1 o'clock, to observers within a radius of visibility. The most important duty of Time Balls lies in the means they afford to ships for checking the rates of their chronometers. For this purpose the Admiralty Dockyard stations round our south and south-west coasts have been provided with Time Balls, some dropped by the Greenwich signal at 1 o'clock, others dropped every hour by an electrical current sent out from a regulator clock which is corrected to agree with Greenwich Time. I should like to refer particularly to two Time Balls which are of some historical interest. That erected on the eastern turret of Greenwich Observatory in 1833 appears to have been the first public time signal in this country, and it has since been dropped at 1 o'clock every day (except when the weather conditions were such as to render it unsafe to raise it preparatory to its

Digitized by Google

drop). The other was erected by the Admiralty at Deal in 1855 at the instance of Sir George Airey, for the benefit of the shipping lying at anchor in the Downs. This is still doing its work, and is worthy of note because it not only gives the time to the ships, but also, by means of a return signal automatically transmitted, informs the Astronomer Royal that it has done so, and whether correctly or otherwise.

Another class of visual signal consists of the deflecting needle of a galvanometer, so often seen in watchmakers' shops. This may be satisfactorily placed in a shop window, for the interest of the passers-by as an advertisement of the fact that a Time Signal is received at that establishment. Whether the signal is utilized or not is of course another matter, but even when placed inside, for use, inasmuch as it requires two observers, one to see the signal and another to observe the clocks, with the very considerable risk of personal error occurring between them, it cannot be of, what one might call *scientific* value.

PHYSICAL CORRECTION.

I now come to the physical correction of clocks. There are many methods, the first being of course hand correction, which may be dismissed at once as haphazard and quite unscientific. There is however one really scientific method of what I may call electro-manual correction, devised by Sir George Airey, which is in use to-day, notably, amongst other instances, on the Mean Solar and Sidereal clocks at Greenwich, and also in the clocks at the Admiralty stations. The Admiralty clocks have two pendulums, beating seconds, one suspended immediately behind the other. The one is entirely free on its suspension but is normally latched to one side by a detent, which is released by the arrival of the Greenwich signal ; the other, which controls the clock, has fixed to it a permanent magnet, which, with the beat of the pendulum, swings just clear of the poles of an electro-magnet fixed to the case. On the release of the free pendulum, should the clock be absolutely to time, both pendulums will beat in phase with each other, but, if there be any variation, the difference in phase may be read on a suitable scale, and then a current sent round the electro-magnet in such a direction as to attract or repel the permanent magnet ; the effective centre of gravity being thus altered, the clock pendulum is accelerated or retarded until it is in phase with the pendulum. These clocks are also provided with electrical contacts to enable them to report their performance automatically to Greenwich. The Mean Solar and Sidereal clocks at Greenwich are corrected in the same way, save that, as their performance is observed on electrically operated seconds indicating dials enabling the clock error to be compared with a transit observation,

Digitized by Google

the free pendulum is not required. There is, of course, in this system, as in all systems where a personal element is introduced, the risk of personal error. There may be an observation error, and the correcting current may also be kept on too long, or not long enough, and even though these errors may amount to but fractions of a second, their possibility precludes the method from being considered an ideal one for general use. I cannot do better than quote the remarks of the British Science Guild Committee contained in the report previously referred to: "The correction of clocks by hand is quite out of date and untrustworthy, and we are unanimously of opinion that some form of direct physical control by electrical synchronization from a central time authority is essential." At the same time it must be admitted that, where the minute correction of fine clocks such as are usually found in observatories and the like places where their correction is in the hands of skilful and trained observers, the foregoing method offers possibilities for closer correction than could be obtained by automatic means.

This brings me to attempts which have been made and methods which have been adopted for direct automatic control.

Automatic Correction.

One of the earliest methods adopted for automatic control was that due to R. L. Jones (1857), some time Manager of the Chester Railway Station. This was a development of Bain's original electrical pendulum in which the pendulum bob was made in the form of a solenoid, in the centre of which was a permanent magnet fixed to the clock case. By means of contacts, electrical currents were caused to alternate through the solenoid in unison with the swinging of the pendulum, so that the coil was given a to-and-fro movement along the magnet. The beats of the pendulum caused the wheels of the train to rotate by means of a ratchet and pawl mechanism. Mr. Jones employed the same type of pendulum, but caused the contacts to be made by the pendulum of another clock, with which, therefore, the coil pendulum beat in sympathy. The exploitation of Mr. Jones's patents was in the hands of the Magnetic Telegraph Company, and I have succeeded in obtaining some figures as to the extent of the system and the costs involved where it was adopted. The figures are not without interest. I find that in Liverpool (1865) a 4-dial turret clock on the Town Hall and a 6-dial clock on the Victoria Tower were thus controlled, £10 per annum being paid to the Magnetic Telegraph Company for each, by way of royalty, rent and maintenance charges. These were, together with a clock in the Magnetic Telegraph Company's Office, controlled by a clock at the Liverpool Observatory. There were also in Glasgow (1864) a number of public clocks (10) similarly controlled from the Glasgow Observatory. The cost of the connecting wires in

Digitized by Google

Glasgow was £40 a mile for wires carried over the houses, and the cost of converting an ordinary turret clock to the sympathetic system was said to be £10, and if the striking gear was also synchronized an additional £15 was required. The royalties amounted to £5 per annum for a public clock and £1 for a private clock, the Magnetic Telegraph Company charging in addition 10s. per annum for batteries and maintenance—which charges were, however, subject to a reduction where a number of clocks were concerned. This system which was also in use in London and Edinburgh, was further developed by Messrs. J. Ritchie & Son of the latter city, and whilst it was really an admirable one, it would hardly compare favourably with most modern systems if current consumption be considered, requiring, as it did, currents to be transmitted every second. I may say that the Post Office has both at Glasgow and Edinburgh a number of these clocks still in use.

Another method, which I believe was originally devised by Mr. C. V. Walker, of the Electric Telegraph Company, was introduced on the South Eastern Railway in connection with the first arrangements for the distribution of Greenwich Time which took place over that Railway. In this system the clocks were made to gain slightly and a disc on the minute arbor was so cut as to allow a pivoted lever to drop when the clock reached the 60th second—sometimes of every hour, sometimes of every twenty-fourth hour,—in such a manner that a detent at the extremity of the lever blocked the escape wheel, thus arresting the clock. The pendulum continued to swing meanwhile, until the arrival of the Greenwich signal energized an electro-magnet, whose armature withdrew and re-set the lever so as to allow the clock to progress as before, but set to correct time. This method has the radical defect that in the event of the failure of the Time Signal, the clock remains arrested unless released by hand, for which auxiliary apparatus is usually provided. Unfortunately, it is practically impossible to guarantee that the wires carrying the signal shall be absolutely immune from occasional interruption. There are several clocks of this type in use at the present day—one at Aldershot (where, by auxiliary electric contacts it controls switches to enable the Greenwich signal to fire the 1 p.m. gun), and also in one or two Post Offices in the North of England. This, too, is the method used for correcting the control clock for the present Chronofer to which I have previously referred.

About 1850 Mr. Alexander Bain (to whom I have previously referred) arranged for a method of what has been aptly termed "forcible correction." This was effected by causing an electro-magnet to move an arm carrying a V-shaped notch so as to engage exactly at the 12 o'clock position with a pin in the long hand of a clock, and thus set the hand to exact time. Mr. F. J. Ritchie, F.S.A., in a paper read

Digitized by Google

before the Society of Arts in 1878, refers to this method, and also mentions that his firm adopted an arrangement (on a similar principle to that of Walker) whereby a movable block was interposed in the way of the pin on the hand so as to arrest the amount of gain accumulated by the clock—the clock having been regulated so as to gain slightly—the obstructing block being sharply removed precisely at the 60th second of the hour. This method of Ritchie's is worthy of note, as upon it is based the present method successfully in use by the Post Office.

Coming nearer to the present day, the Standard Time Company originally made use of a forcible correction method devised by Mr. Lund, whereby two pins, carried upon separate arms capable of revolution through an arc of about 70 degrees, were caused, by the operation of an electro-magnet, to bear upon a block attached to the minute hand, which was moved backwards or forwards, according as to whether the clock was fast or slow; the hand being released when in the correct position. This method of correction was ultimately abandoned for another, which "zeroised" the hands by the action of a shaped piece, attached to an armature, upon a suitable cam fixed to the centre arbor. As a matter of fact, the majority of the methods for zeroizing clocks by means of a synchronizing current in use at the present time, depend upon the action of a lever or roller caused to come into contact with and push round a spiral cam or its equivalent. With certain restrictions, this method—a fairly obvious one—is reasonably good.

When it was decided that the Post Office should consider the question of extending the application of the time current for synchronizing clocks, the methods previously in use, some of which I have described, were very carefully analyzed, and, after experimenting at some length, several rather important conclusions were arrived at, amongst others that the periodic checking of a gaining rate—as in Ritchie's method—was fundamentally correct. If an attempt is made to move a slow clock forward, backlash that must perforce exist in any train of wheels has to be dealt with; such an attempt would disengage the teeth of the train from their driving position, which space would afterwards have to be gathered up when the correcting power ceased to apply; the obvious result being to leave the clock incorrect. This, of course, does not occur where setting back or checking a gain is concerned, for the engagement of the teeth of the train is not disturbed. Again, the adoption of the Walker system, whilst doubtless useful for seconds-indicating clocks—there are but few of these in the Post Office—entails alterations and additions approaching to a partial reconstruction of the clock, and is therefore comparatively expensive to apply, unless the clock be specially constructed for synchronization; but nowadays one does not, as a general

Digitized by Google

rule, design clocks specially for synchronization, because a purely electric system with but one synchronized master clock meets the case more satisfactorily and more economically. The problem which had to be considered was the synchronization of clocks that were already in existence. Further, an important desideratum recognized was that whatever be the method adopted, the additional part or parts to be added to a clock must be of such design as to be readily incorporated in all the classes of clock that are in use in the Post Office, from 10-in. timepieces up to comparatively large 36-in. dial clocks, and above all, the apparatus and its fixing must be reasonably cheap.

POST OFFICE SYSTEM.

A small electro-magnetic detent was therefore designed in the Engineer-in-Chief's Office, G.P.O., which can be readily attached behind the dial of any timepiece and in which the magnet has no positive work to do. The pin in the armature is arranged to project through a hole in the dial in such a way that periodically, when the minute hand reaches the 60th minute, it engages with a flattened pin riveted to the hand. With the magnet unenergized, the pin on the hand easily pushes the detent pin forward, and, because of the different arcs in which the pins move, ultimately clears it. If, however, the magnet be energized, the armature is simply locked in position (which, of course, requires much less effort than actually to move the armature through any distance) and then, by the engagement of the pins, the clock is held up, the hands meanwhile slipping on their arbors without stopping the train, until at the cessation of the current, the hands are allowed to progress. I may add that the electrical resistance of the synchronizers used on Post Office installations is 10 ohms, and that all the clocks in a building are connected in series, the voltage at the master clock being regulated so as to afford a current value of about 250 milliamperes in the circuit, whatever be the number of clocks. Actually, 100 milliamperes are ample, but it is found to be safer to allow a wide margin.

The Post Office has not standardized any fittings for correcting turret clocks. These are usually made to order, one at a time, and they vary so much in detail that an attempt to apply a standardized attachment might prove rather expensive. The same principle, however, is employed. It will be recognized, of course, that with a large turret clock there is some justification for a rather more expensive fitting than would be the case for the more numerous small clocks, yet the cost of applying the method I have described does not nearly approach the figures quoted in connection with the Jones sympathetic system to which I have already referred. It may be interesting to note that, for a number exceeding twelve clocks in one building, the cost of the Post Office system, including all wiring and a Master

Digitized by Google

Clock which I shall presently describe, averages approximately no more than £1 per clock.

The Master Clock adopted by the Post Office for transmitting the correction currents differs considerably from that described by the committee of the British Science Guild in their second report. At that time the Post Office used, tentatively, a clock of the Vienna Regulator type, to which was added certain extra parts to enable it to be synchronized daily by the Greenwich signal, and also to send out in its own local circuit the hourly correction currents to the secondary clocks. This type of clock required to be wound up periodically, and of course was fulfilling a function for which it was not primarily designed, being therefore something in the nature of a makeshift. The Post Office, however, uses a Master Clock which is more of the nature of a time-controlled switch than a clock. This consists of a pendulum, electrically driven on the Hipp principle, which, through a pawl and ratchet wheel, drives a worm gear connected to a very simple train of wheels, embodying 1-hour and 24-hour wheels. The 24-hour wheel is provided with cams which operate, at the proper time, electrical contacts controlling automatic switches for the proper reception of the 10 and 1 o'clock Greenwich signal. The hour wheel carries a pin which, once an hour from the 58½ minutes before the exact hour, depresses a lever to make the circuit for the hourly correcting signal. The lever is released, and thus breaks the circuit, precisely at the 60th second of the 60th minute of the hour. The arbor of the ratchet wheel carries a heart-shaped cam, by means of which an electro-magnet armature provided with a roller extension zeroises daily the whole of the train. It is obvious that synchronizing by a cam in this case, on the quickest moving member of the train, is not open to the objection which would apply, as I previously remarked, to the same method applied directly to the minute arbor of a clock. Incidentally, I may mention that this Master Clock is identical with the control clock utilized in connection with the new Time Distribution scheme for Sub-Chronofer Stations to which I referred earlier in the paper. In view of the fact that telegraphic interruptions *do* occur occasionally, the electrical circuits are so arranged that a false synchronizing signal will be rejected by the clock, and the entire failure of the signal cannot interfere with the normal movements of the clock.

So far as the Post Office is concerned, where the equipment of a new building or one hitherto not adequately provided with clocks is concerned, a purely electric system whose master would be automatically synchronized is now invariably installed.

As a matter of fact, the provision of the timekeeping arrangements for Government buildings has devolved upon H.M. Office of Works, which has equipped many buildings, including Post Offices, with the Magneta Clock system. The Master Clocks in connection with these

Digitized by Google

installations are wound up daily, and the necessary corrections are made at the same time, that is to say, at the present time they are not automatically controlled.

I do not propose to enter into considerations as to the relative merits of the several excellent electric systems available to-day. Claims are made by each system that it possesses higher efficiency, better timekeeping qualities, and greater economy than the others, so that a choice must be largely governed by individual opinion. In my opinion, an ideal system should consist of a Master Clock, which should be entirely independent of personal attention for winding or correction, and which should lend itself readily to automatic correction, connected to secondary clocks in which the moving parts should be as few as possible and coupled with driving mechanism of the rotary type—akin to an ordinary electric motor. It is true that ratchet and pawl mechanisms, as used in many electric systems, have been brought to a wonderfully fine degree of perfection by many able and skilled inventors and designers, nevertheless, I am of opinion that for absolute satisfaction a motor mechanism is the ideal one. I am led to this opinion because of past experience with electric clocks in the Post Office. In 1896, when the Post Office acquired the Telephone Trunk wires the need was felt for large clocks indicating periods of ¼ minutes, and Mr. Kempe, the Electrician to the Post Office, designed clocks which were operated by rotary armatures to meet this requirement. These clocks, made more than 15 years ago, are still in use, and are doing their work quite satisfactorily, much more so, I feel sure, than if they had been driven by ratchet work, which would have involved some measure of adjustment to take up wear and more or less variable springs which are almost inseparable from that type of gear. These particular clocks, designed some time before the electric clock industry had reached its present stage of perfection, are unique, inasmuch as, in addition to the ordinary hour and minute hands, they were provided with a third concentric hand which revolved once a minute in four jumps of quarter of a revolution, each representing ¼ minute. The clocks were made in two sizes with 24-in. and 5-in. dials, similar driving mechanism being employed in both sizes. They are now, however, being replaced by other instruments, one of which indicates to the operators the lapse of periods of three minutes,—the unit time for trunk conversations—and another which is caused to print on a ticket the time elapsed between the commencement of a conversation and its termination.

I should also like to say that where Master Clocks are synchronized, the method adopted, whether a zeroising method or a modification of the Ritchie method such as is often used, arrangements should be made that the operation be *entirely* automatic, and not dependent upon manual adjustment in the event of any failure of the original.

Digitized by Google

In either case it is easily arranged for, and I am surprised to find that cases actually exist where the failure of signal has stopped the system.

GENERAL.

I hope I have now shown in as concise a manner as is compatible with lucidity how standard time is obtained, how it is distributed, and how it is used.

The importance of punctuality is widely recognized, and we are ready to admit that "Time is the Soul of Business." It can then only be a matter for wonder that comparatively so little has been done to ensure that the hour of day indicated by our clocks, both public and private, shall register the correct time. The tailor is careful that his yard measure is a true one, and the grocer that his weighing appliances register correct weight. Everything that we have, everything that we do, everything that we see, is governed by some measure. We ourselves, or the law for us, insist that these measures, save one, *Time*,—shall be true; yet Time is, and should be, inseparable from its brothers of *length and mass*. This sense of incompleteness is all the more striking when one considers how comparatively little used are the ample facilities which the national possession of the telegraph system of the country places at our service for distribution. However, before I bring my paper to a close, I may perhaps be allowed to refer to one great branch of our human existence where correct time is fully appreciated, and where any increase in the facilities for accurate and wide distribution is welcomed and made use of without stint. I refer to our Navy and our Mercantile Marine. Our ships, both those upon which we largely depend for our trade, and those which defend our shores, are increasing in numbers and value daily. The navigator, whether he be in mid-ocean or sailing round a coast, must at all times be in a position to locate the whereabouts of his ship. Under the latter circumstances, the task may often be a simple one, owing to the existence of visible stationary objects; but in the former case, a means of ready reference to standard time is essential to the navigator, if he is to fix his position accurately.

Fortunately, recent developments in telegraphy have provided means whereby time signals can be transmitted to every part of the wide ocean, and the navigator now has the benefit of both the radio-telegraphic station on the Eiffel Tower and the German station at the mouth of the Elbe, for obtaining standard time, Paris time in the former case (for, although France now uses Greenwich time commercially, yet Paris time is employed for maritime purposes) and Greenwich time from the latter; which are radiated far and wide for the benefit of all who have means for listening to them. From the Eiffel Tower, signals are despatched in the forenoon and again at

Digitized by Google

midnight. Three groups of warning signals are transmitted by hand, and each group is of a distinctive character, so that listeners may be prepared for the actual time signal, which is sent automatically, and in order that there may be no doubt as to the signal, the time signal is repeated thrice at intervals of two minutes, that is, at 11, 11.2, and 11.4 a.m.; and midnight, 12.2, and 12.4 a.m. The cost of the apparatus necessary for the reception of these signals on ships unprovided with radio-telegraph apparatus, is from £10 to £20, not a large sum when compared with the immense value of the service thus obtained. Aerials having an elevation of about 20 metres are sufficient for vessels within a radius of about 200 miles. The facility afforded by radio time signals is of immense value also in surveying operations, as providing means for obtaining most minute differences in longitude.

In concluding, I desire to acknowledge my indebtedness to the archives of the British Horological Society for much of the historical matter embodied in this paper.

Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(*Continued*).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

THE English troops—Napier tells us—were now distributed in Badajoz, Elvas, Campo Mayor and other places, and this eventful campaign of two months terminated.

On the whole, it has been unfortunate, though relieved by the victory of Talavera. The general loss of the British—Napier goes on to state—was considerable. Above 3,500 men had been killed, or had died of sickness, or fallen into the enemy's hands. 1,500 horses had perished from want, exclusive of those lost in battle; the soldiers were depressed, and a heart-burning hatred of the Spaniards was engendered by the treatment all had endured. To fill the cup of disaster the pestilent fever of the Guadiana, assailing bodies which fatigue and bad nourishment had already predisposed to disease, made frightful ravages; dysentery, that scourge of armies, raged, and in a short time several thousand men died in the hospitals.

The British General had learnt a lesson which was not forgotten during the rest of the war—that no reliance was to be placed on Spanish co-operation. At the same time, he was determined to protect the Spanish peasantry from the predatory excursions of his soldiers, as was made manifest to the whole army by his orders on the subject. Thus under date September 7th, 1809; "Notwithstanding the repeated orders given out upon the subject, the soldiers of the 4th Division of Infantry plundered beehives, in the neighbourhood of Badajoz: it is impossible these outrages can be committed daily, without the officers obtaining some knowledge of it. The officers with the army do not appear to be aware how much they suffer in the disgraceful and unmilitary practices of the soldiers, in marauding and plundering everything they lay their hands upon. The consequence is, the people of the country fly their habitations, no market is opened, and the officers, as well the soldiers, suffer in the privation of every comfort and every necessity, excepting their rations, from the neglect of the former, and the criminal misconduct of the latter." And again, September 12th; "The 4th Division having again, in three instances plundered beehives, etc., etc.," severe punishment was meted out to the entire division, "till the soldiers shall have been discovered who have been guilty of these outrages."

Digitized by Google

During the pause that ensued, while the army was settling into quarters about Badajoz, some interesting occurrences are thus briefly alluded to by our diarist.

Sept. 9th. We this day received the Gazette account of the Battle of Talavera; His Majesty's thanks in General Orders, and also letters from our friends in England.

Sept. 17th. Dined for the first time with Sir Arthur Wellesley; after dinner we drank his health as Viscount Wellington, when he first assumed the title.

Oct. 7th. This day Lt.-General Sherbrooke was invested with the Order of the Bath for his services at Talavera.

BADAJOZ, *September 12th*, 1809.

MY DEAR FATHER,

. . . I have also received a letter from you in which you were kind enough to desire that I would draw upon you for what money I might want; I beg to return you many thanks for your continued and more than fatherly goodness and forethought on my account; but am happy that I am able to go on without troubling you at this moment. From the nature of my duty as Adjutant, Qr.-Mr. and Paymaster to the R.M. Artificers, and indeed from the known good conduct of our officers, I can get whatever money I want from the Ordnance Paymaster, subject to a settlement at the end of our campaign; should it soon close I fear I shall be a little in want when we arrive in England; but if it continues a few months longer I trust I shall be pretty clear with the agents. This you can account for when you recollect the expense I have been at for horses, etc., and indeed although we endured for some time every privation of meat, drink, etc., short of absolutely starving, yet even at that moment we spent a good deal of money from the avidity with which every morsel of anything eatable was bought up at any price. Since I have been Adjutant I have lived with Col. Fletcher, and indeed manage the table, etc.; this is of course more expensive than living with another of our officers when attached to divisions, but at the same time it is more comfortable, as the Col. always gets a quarter near Sir Arthur's, and as the nights begin to get colder it is pleasanter sleeping in a house than in the field with the troops. It is now extremely warm in the day and rather cold in the night, which is very unhealthy and may perhaps account for the number of our sick, which is more than 10,000 including the wounded we left behind at Talavera. Our cavalry still continues in a very bad state. General Cattin Craufurd has this day joined us with seven or eight new regiments but for what purpose it is impossible to say; we begin to suspect that Ministers are mad enough to think of continuing to support the allies we have found in this country; if so I doubt not we shall do our duty in the next general battle, but should not be surprised if it ends in our ruin; we cannot afford to gain another victory at the price we paid on the field of Talavera. Out of less than 18,000 men which was our total that morning, 5,300 were either killed, or wounded, or taken before the action ended, and we have been obliged to leave 2,200 and odd behind at Talavera who of course have

Digitized by Google

fallen into the enemy's hands (by the bye we have heard from Boothby of ours who lost his leg ; the French Army are vying with each other who should show our wounded the greatest attention). At Plasencia we left 600 sick, at Oropesa 200, and they are daily dying in the hospital at Elvas. You will think this a gloomy account, but I assure you it is perfectly correct, and so far from being in the dismals or melancholy, whilst writing this, you must know that I am in high spirits, that the weather is fine, and that we all feel not a little proud and gratified at the very handsome manner in which the King has been pleased to notice our conduct and to acknowledge it in General Orders to the rest of the army. I really think we ought all to have medals as well as the officers commanding corps ; but at all events we expect to have Talavera on our appointments, etc.

I wrote to you last from Truxillo, since that we marched to Merida, and from thence, after halting 10 days, we arrived here on the 3rd instant. The army are all near this town. . . . Head Qrs. are here. This place is very strongly fortified for a Spanish town ; but its situation is rather unfortunate, being commanded on most sides ; it is about 120 miles from Lisbon to which city runs a good and level road. I suppose we shall halt here until the French choose to drive us from hence. This is a good large town and has never been plundered ; everything may be had, but unreasonably dear. . . .

I have some idea of drawing a plan of the Battle of Talavera upon thin bank paper as soon as I have time and sending it in a letter to him—(Sir W. W. Wynn) do you think he would like it? You have not told me how Hollyhock goes on ; I begin to think I shall still want him before this year is ended. I wish much I could get a newspaper sent ; it is the greatest curiosity we can get! If we are not likely to quit this country soon, I wish much to have a newspaper at least once a week ; I would write to Mr. Wharton about it, but I fear it would be very uncertain from him ; the person at Foreign Department of the Post Office is the best if you know them. I sometimes see *Bell's Messenger* of one of our officers ; therefore I do not wish that. Is it possible to get the Cambrian, Shrewsbury, or Chester papers to see the Welsh news also ?

Your loving son,
RICE JONES.

While at Badajoz, Rice Jones took the opportunity of inspecting the neighbouring fortress of Elvas, on the Portuguese side of the frontier, and Fort La Lippe—so called after that distinguished soldier, the Count La Lippe, who had been sent at the request of the Marquis of Pombal, in 1762, by the British Government, for the purpose of reorganizing the Portuguese Army and commanding it during the war with Spain. The fort bearing his name is the sole remaining memorial of his work in Portugal : he designed it, and superintended its construction.

Elvas, previous to the French invasion, must have been a pleasant town. Beckford, on his visit to it in 1787, found the ramparts "laid

Digitized by Google

out and planted much in the style of our English gardens, and forming very delightful walks."

Badajoz—apart from its military importance, was not without interest; for it was there that the Italian traveller, Baretti, met his old friend, Dr. Merosio, whose English wife could boast of the most extraordinary adventures that probably ever befell a woman of gentle birth. She had been in the four quarters of the world, and could speak several languages, including that of the native Indians in the neighbourhood of Goa, where she had resided as a maid-of-honour to the unfortunate Marchioness Tavora who was beheaded at Lisbon in 1758. She had also been in Japan with her first husband, a Dutch physician, to whom she was married at Batavia. After her return to Europe, she had been taken in a Portuguese ship by a Salee pirate, and would probably have passed her whole remaining life in captivity had she not been an Englishwoman; for, as such, she was redeemed along with the crew of an English vessel called the *Litchfield* which had been wrecked on the Barbary coast. After three years' captivity, she had been landed at Gibraltar, whence she wrote to her husband that during her residence in Morocco she had become a great favourite with the Sultana, and that the presents her mistress had made to her at parting would more than suffice to enable them to pass the remainder of their days in comfort. "A narrative of her life," adds Baretti, "would make a fine book, and if I see her in Italy, I will spirit her up to it, and offer her my services towards the work."

On October 8th Lord Wellington, accompanied by Col. Fletcher and Col. Murray set off for Lisbon, where they were followed by our author and several of his brother officers, halting at various places on the way, with varying accommodation. Thus at Vendas Novas, "We were billeted upon an Estalagem (Inn) where we were tolerably comfortable; we were obliged to sleep upon straw beds, but procured a very fair kind of dinner." Crossing the Tagus at Aldea Gallega, the party landed at Lisbon on the evening of October 12th—"went to my old landlord, No. 12, Rua Larga de San Roque, who invited me to take up my abode in his house again, which invitation I was induced to accept."

The following entries all have reference to those extensive defensive works for the protection of the capital, and—if the necessity arose—for covering the embarkation of the British Army, which became known as the "Lines of Torres Vedras," and which Lord Wellington decided on constructing, after consultation with his Chief Engineer, Col. Fletcher.

"The determination to commence these works," (the Lines of Torres Vedras) says Sir John Jones, "may be dated from the Battle of Talavera, when it became apparent to the Duke of Wellington that the contest would, in the next campaign, devolve on the small body of veteran British and newly-raised Portuguese troops under his command, and a defensive system of warfare ensue."

Digitized by Google

Oct. 14th. Rode to Fort St. Julian to sketch the ground intended to be occupied with a work. *Oct. 15th.* I was this day employed in drawing a plan of the ground I sketched yesterday. *Oct. 16th.* Colonel Fletcher accompanied Lord Wellington on an inspection of the country towards Sacavem and Castanheira. *Oct. 23rd.* Col. Fletcher accompanied Lord Wellington to Setubal. *Oct. 25th.* This being the 50th anniversary of our Gracious King's accession to the throne, we went to the Opera where a suitable ballet was performed. *Oct. 27th.* Lord Wellington left Lisbon to join the army at Badajoz. *Nov. 2nd.* The Col. and all the other officers (Royal Engineers) who have arrived from the army set out for Sobral, leaving myself and two others in Lisbon.

LISBON, *October 22nd*, 1809.

MY DEAR FATHER,

I have been for some time most anxiously expecting to hear from you; your last letter being more than two months old. . . . As I know you are extremely good, and particularly about writing, I begin to think some of your letters have miscarried. I hope to God nothing has happened to prevent your writing.

You will no doubt be surprised to find this letter dated from Lisbon until I inform you that Lord Viscount Wellington set out from Badajoz for this place on the 8th instant, accompanied by a few of his staff, the Qr.-Mr.-Genl. and our Chief in whose suite I have travelled thus far, together with Capt. Chapman. There are a number of reports on the subject of this visit. I know that his Lordship and the Col. have been riding all over the country for 30 miles round, and have nearly knocked up Col. Fletcher's stud; from which it is easy to conclude that the ground to be occupied for the defence of Lisbon is a material part of the Commander of the Forces' business at this place. I will also tell you what is an impenetrable secret at present even to our officers; viz., that *all* our Corps are ordered from the army to a place called Castanheira, about 30 miles higher up and on the same side of the Tagus as this city. The Col. talks of setting out for Castanheira to-morrow or the next day; I of course shall accompany him, and understand there are a great number of works in contemplation. These measures look too much like a determination on the part of Ministers to defend Portugal to the last extremity; that extremity will certainly arise as soon as the French are able to advance in any force, and we shall then very likely have just such a scramble to get off as the army at Corunna had last year. If we are obliged to fight another battle I do not doubt but the victory will be ours; but an army in the state of ours at this moment cannot afford to purchase victories at the rate we paid for that of Talavera. These are not more my sentiments than those of almost every officer in the army—not excepting the Second in command, the Staff or Chief Engineer.

The above is the state of politics here; we are looking most eagerly for yours in England. We daily hear of new ministries, partial changes, etc., but know not what to think will be the result. The Ambassador, Mr. Villiers, quits this country shortly, and Sir Rt. Wilson goes home on

Digitized by Google

leave, I believe, in the same packet with this letter; he talks of returning in two months.

In my last letter I mentioned my intention of sending Sir W. W. Wynn a sketch of the scene of action at Talavera, and had actually begun upon it when I was suddenly ordered to this place, since which time I have been unable to do anything more towards its completion. . . . Since writing to you last, I continue in good health, although I feel rather weakened or debilitated, which can easily be accounted for from the very exceptional heat we always experienced in Spain during the days, and the comparatively great cold of the night, which latter circumstance we of course felt more in consequence of sleeping out without cover and being in want of meat and drink. I have however great reason to be thankful I continue so well as I do, the army being in general in an unhealthy state still. Our future operations are likely to be for some time in a good country with plenty of provisions, etc., and, I fancy, without being eaten up by the rest of our army. I shall now conclude, begging you will be so good as to give my best love to my dear mother and to my dear brothers and sisters. . . . Since my last letter I have had the pleasure of remembering three of them on their birthday. . . . You see I keep a correct Roster.

I am, my dear father,
Your loving son,
RICK JONES.

During the next few months, Jones was actively employed on the construction of the works at the western extremity of the Lines of Torres Vedras. The actual commencement of these celebrated defences took place on the following dates, respectively:—St. Julian, November 3rd; Monte Agraça (the great redoubt in the centre of the position, overlooking Sobral), November 4th; Torres Vedras, November 8th.

Reverting to the Diary:—*November 29.* Rode to Sobral, where I mustered and paid the artificers. Returned to Lisbon after looking at the works.

December 9th. My dear father's birthday, may he enjoy very many and happy returns of it. The army began to move from Badajoz to the north of the Tagus. Sold the horse I bought at Zaza la Mayor for 30 Dollars.

LISBON, *11th November*, 1809.

MY DEAR FATHER,

I am quite at a loss to account for my not having received a letter from you yet, and the more so as I know you are very regular about writing. The last letter I received from you was dated the 17th August immediately upon the receipt of my letters from Talavera; since that time I have written to you from Truxillo, from Badajoz, and lastly from this place on the 22nd ult. Three Packets arrived here a day or two ago, having been due for some time; they have brought letters to the beginning of this month; I fancied I was certain of receiving a letter at least amongst the three Packets, and you may perhaps conceive my disappointment at

Digitized by Google

finding none. I assure you I begin to feel quite uneasy, fearing that something or other has happened to prevent you writing. To hear from you is the only comfort I can enjoy in this country, and I am now very melancholy at times in consequence of my present deprivation of that pleasure.

Lord Wellington left us here on the 27th ult., to join the army at Badajoz, and has since that gone to Seville. Our troops occupy their old line from Merida to Badajoz, and a most unfortunate line it has been for us. In one of my last letters I told you how very unhealthy the army were, and I now understand that the sickness increases rather than diminishes, so that if we occupy our present ground long (which is notoriously unhealthy even for the natives) our army will soon be in an extremely bad state to take the Field. Officers in a state of severe illness arrive here daily from the army, and many have been obliged to go to England. All the officers of our Corps, who, as I before informed you were ordered from the army, are now distributed at Fort St. Julian, Torres Vedras, Sobral and Castanheira; at three former places works are now throwing up; at the latter we are making accurate plans of some positions. I am the only officer here except Hamilton who continues so lame since he was wounded at Oporto that he cannot walk about, even in the house, without difficulty. I have had a good deal to do here since the Colonel has been gone; all his correspondence necessarily passes through Lisbon, where the Depôts of all kinds, as well as the heads of departments, are; for this reason, principally, the Colonel left me here when he went away; although I believe he was fearful that my health would perhaps suffer by much exertion out of doors, and thought I could be useful here, which I trust the event has proved. I am a good deal better and stronger than when I first came here; I have not yet been ill, although I am in general far from well; I am taking Bark at present. The Colonel behaves extremely kind to me in every respect. Although I volunteered accompanying him as usual, he would not allow me, until the doctor says I am stronger.

I am not certain whether I told you in my last letter that I am in my old Quarters; my landlord very civilly kept them for my return, and insisted upon my occupying them, without another billet. I am billeted on the same house as the Colonel, which is usually the case; but, however, as our accommodations were not on the grandest scale, I determined to comply with my landlord's kind wishes. With assurances of my best love to my dear mother, and to all my dear brothers and sisters,

I remain, your affectionate son,

RICE JONES.

P.S.—Be so good as to make my compliments, etc., which I generally trouble you with, to Sir W. W. Jones and all the family. Let me know what is going on in England and also in Wales. We cannot imagine what will become of us amidst all the changes, etc., which are taking place.

LISBON, *December 16th*, 1809.

MY DEAR FATHER,

It was with great pleasure that I received your kind letter of the 20th ult. two days ago, and found you all still enjoyed your health; many thanks for the enquiries and directions you have sent me. I am now very well

Digitized by Google

thank God, and feel as strong as ever. I had quite forgotten that Mr. Steed was in the Royal Dragoons; they are quartered at Belem, about 3 miles from this city. I will call upon Mr. Steed when I ride that way next, for I like much to see any of my own, or of my dear father's acquaintances; I recollect him very well when I was a Cadet. I am very much obliged for the news you give me; you cannot imagine how eager we all are to know what is going on in England; our fate will depend, I suppose, in great measure upon the stability of the Ministry. If you are in London, will you have the goodness to see if it is possible to send me a weekly newspaper; I understand the only way of ensuring its regular arrival is by getting it from the person who is at the Foreign Branch of the General Post Office. I sometimes see *Bell's Messenger*, but as it belongs to another of our officers, it very often happens that he is not quartered with us, and we then, of course, miss it. I believe there is one weekly paper (I think the *Phœnix*) which has the Gazette Promotions in it, but of this I am not certain. You will very likely think that the Promotions will not much concern me; but I must remind you that I do not expect to be many months of my present rank in the Service. As I form part of the Colonel's family, he will, I know, be glad of my getting a paper, for he has only Motley's Portsmouth one, which arrives but seldom, and then about a month or two in arrears.

Col. Fletcher has been here about nearly a fortnight, but is now gone again upon his circuit of the Works in this vicinity; he has determined upon my remaining here as the most central spot to conduct his correspondence. Everything in our Department goes on as well as can be wished in this country; but it is said that such was not the case with the Army before Flushing. Pray tell what is said about it in England; we of course wish to know how the Corps get on in other parts of the world; but are very seldom favoured with intelligence. Capt. Goldfinch remains here to superintend and report upon the works the Portuguese have been throwing up near here. Ross is gone back to join the army; he begged his compliments to you and my dear mother. The Colonel talked, whilst he was here last, of endeavouring to obtain Lord Wellington's permission to join the army when he next returned to Lisbon, as by that time (about three weeks or a month) the Works will be so far completed as not to require his presence. If he goes, I shall of course go with him, for he has repeatedly promised me that if he is in action I shall be so likewise. The others, I fancy, will remain until everything is completed. The Colonel has some anxiety to join the army, thinking it probable the French may receive the reinforcements which will undoubtedly be sent them, sooner or later, to enable them to attack us before April or May. Be that as it may, I am glad our army has quitted Spain—I hope for ever; it has been an unfortunate country for British armies. On your Birthday (which I assure you did not pass without many a sincere wish that you may enjoy many, very many happy ones yet) the army began their march towards Portalegre, and are to cross the Tagus at Villa Velha and Abrantes; the latter place is to be once more Head Quarters; our advance will be at Castello Branco; Abrantes being only 90 miles off, with a good road, plentiful country, and some good positions for defence, and the river Tagus navigable all the way up, is in every way a preferable

Digitized by Google

situation to the banks of the unhealthy Guadiana, from Merida to Badajoz. I do not doubt but our troops will soon be restored on the banks of the Tagus to that health which they almost all lost on the banks of the Guadiana. I am as unfortunate as ever in horses; a beast of a baggage-horse that I bought whilst on a reconnoitring expedition in Spain, was upon my arrival here completely knocked up, as well as myself. Ever since I have been endeavouring to recover him for a march, but to no purpose. I was therefore glad to accept 30 dollars for him yesterday, as he was daily getting worse. I gave 60 dollars for him; you will therefore perceive my loss is 30. I expect I shall be obliged to give about 80 dollars to replace him. My servant William behaves extremely well; he has been very ill indeed, but is now tolerably well recovered. . . .

Your very affectionate son,

RICE JONES.

P.S.—I now learn that part at least of our army are to march through Leyria, and very probably thro' Coimbra; this is to me utterly inexplicable; however, a few days must inform us when and wherefore these movements are made.

December 17th. Taken ill this evening. *December 22nd.* The first day I have been able to dine at the Mess since Sunday, having been confined by a sore throat. *December 27th.* Rode to Torres Vedras through Loisa to the left of the Cabeca de Monte Chico. Mustered and settled with the artificers, and afterwards went round the works. *December 29th.* Rode from Torres Vedras to Sobral, thro' Runa, Ribaldeira, and Dous Portas; settled with the artificers. *December 30th.* Rode from Sobral to Aruda, from thence to Castanheira. *Sunday, December 31st.* Went to Carrigada with Chapman; fixed upon the Quinta of the Conde de Loisa for our quarters. Rode to Lisbon to dinner.

And here a few words of explanation with respect to the manner in which the works were constructed may prove of interest to the non-professional reader. Major-General Sir John T. Jones, R.E., who, as a captain was employed on the Lines, tells us that the position and nature of the several works having been determined on, these were pressed forward; and that the young officers of Engineers, now, for the first time, placed in charge of extensive districts "exerted themselves with a zeal which knew no limits, and everywhere throughout the Lines a spirit of honourable emulation proved highly advantageous to the progress of the work." The peasantry of the country were put into requisition as labourers; overseers, directors, and artificers were furnished by a detachment of British infantry, and "no petty cavils about official forms of expenditure were allowed to impede the supply of materials and stores."

It was a novel *rôle* for young officers, and the duties proved excessively arduous; but there were compensations. To quote from Sir John Jones:—"The British officers, spread singly over a space of

Digitized by Google

150 square miles of country, and billeting themselves in the best and most convenient houses, were everywhere treated with civility and kindness by the inhabitants, and a general readiness was shown by the upper classes to admit them to the familiar society of their families, which led to many sincere and disinterested friendships being contracted between the individuals of the two nations. Indeed it is but a tribute of justice to the Portuguese gentlemen and peasantry of Estramadura to state that, during many months of constant personal intercourse, both public and private, the latter ever showed themselves respectful, industrious, docile and obedient; whilst the former in every public transaction evinced much intelligence, good sense, and probity, and appeared in their domestic relations kind, liberal, and indulgent, both as masters and parents."

In order to realize the anomalous nature of the situation created, we must try and picture what the attitude of our own people would have been, *vis-à-vis* of a number of young Portuguese officers placed in charge of the defensive works which were being constructed along the south coast of England at the time of Napoleon's threatened invasion. The truly admirable behaviour of the Portuguese, of all classes, under very trying circumstances was worthy of commendation.

(*To be continued*).

Digitized by Google

TRANSCRIPTS.

SPECIALIZATION OF ENGINEER SERVICES IN THE AUSTRIAN ARMY.

We are indebted to the Army Council for the following:—

(1). The attached paper may be of interest, as typical of the tendency to specialization of engineer duties, which has been lately noticeable in the Austrian Army. The Engineer Staff and the Military Works Department have long been separated from the so-called "Technical Troops," to which all ordinary engineer duties in the field were allotted.

(2). Until the beginning of this year the "Technical Troops" consisted of—

(*a*). The Railway and Telegraph Regiment.
(*b*). The Pioneer Troops.

(3). The Railway and Telegraph Regiment has, in the course of this year, been split up into two distinct regiments—

(1). The Railway Regiment.
(2). The Telegraph Regiment.

These two regiments, have been allotted to a newly organized formation, known as the "Communication Troops Brigade" which includes, besides the Railway and Telegraph Regiments, the Army Air Corps, and the Automobile Service. The Brigade occupies a peculiar position, in that, for all matters other than discipline, it is directly under the orders of the General Staff of the War Office.

(4). The remaining "Technical Troops" known as the Pioneer Troops are now to be divided into two distinct branches, under the designation of Sappers and Pioneers respectively, for land and water duty respectively. Although it is admitted that the work of the two branches must to a certain extent overlap, it is claimed in the Austrian military press that increased efficiency, especially under the conditions of the newly introduced two-year service, will result.

Reorganization of Engineer Troops.

(From *Fremdenblatt*, July, 1912).

The 15 battalions of Pioneer Troops are to be divided into two separate independent branches, viz.:—

(*a*). Pioneers (Pioniertruppen), for all river and stream work.
(*b*). Sappers (Sappeurtruppen), for all land work.

Digitized by Google

There will be 14 sapper battalions and 8 pioneer battalions. In addition there will be special formations for bridging and submarine mining (in connection with rivers). There will be two Inspector-Generals, one of sappers, and one of pioneers.

(1). The duties of the pioneers will include bridge-building of all kinds, work in connection with barges and water transport of all kinds, (except marine). Care of water lines of communication. To a smaller extent, demolitions, use of explosives, field fortification, care and construction of roads.

(2). The duties of the special formations will be—

(*a*). The Bridging Battalion—construction of semi-permanent bridges, employment of the transportable iron bridging material.

(*b*). The River Submarine Company—all work connected with the mining of rivers.

(3). The duties of the sappers will include all work connected with the attack and defence of fortresses, field fortification of all kinds, demolitions and the use of explosives, construction of temporary and semi-permanent bridges, care and construction of roads. To a smaller extent, railway and telegraph work.

(4). The sapper battalions are to be consecutively numbered from 1 to 14. Each battalion will consist of three companies, except No. 14 which will have four.

The pioneer battalions are to have the numbers 2, 3, 4, 5, 7, 8, 9, 10. Each battalion will consist of four companies. The missing numbers 1 and 6 will be represented by the new special formations, viz. the River Submarine Company and the Bridging Battalions. These are to be formed from the present cadres which now form part of No. 1 and No. 6 Pioneer Battalions respectively.

The new organization is to come into force forthwith.

A. H. OLLIVANT.
Major, G.S.

War Office, S.W.

Digitized by Google

REPORT ON ARTIFICIAL ILLUMINANTS, OTHER THAN ELECTRIC, SUITABLE FOR BARRACKS, WORKSHOPS AND LARGE OPEN SPACES.

(*Concluded*).

By CAPT. L. N. MALAN, R.E.

C.—ACETYLENE.

1. *General.*—Acetylene and its uses is fully discussed in *Acetylene* by Leeds and Butterfield, published by Griffen & Co., so that only a brief description is necessary in this report.

2. *Nature of Calcium Carbide.*—Acetylene is a gas produced by the action of water on calcium carbide. Calcium carbide (CaC_2) is a solid that can only be made on a commercial scale in the electric furnace in which lime and coke are subjected to great heat; and it is therefore beyond the power of the user to manufacture. No heat possible of attainment short of the electric furnace has any effect whatever on carbide, but when treated with a liquid that is essentially water, or that contains water, an inflammable and on occasions an explosive gas is at once evolved. Carbide must therefore be stored in air-tight tins or drums to which no moisture can in any way penetrate, for in the absence of this precaution the storage of carbide will always be attended with considerable risk of fire, a point which should by no means be overlooked. Special rules for its storage are given in the above-mentioned work, to which a reference may be made.

3. *Generation of Acetylene.*—When water meets with calcium carbide, acetylene (C_2H_2) and lime (CaO) are produced, the chemical formula being—

$$CaC_2 + H_2O = C_2H_2 + CaO.$$

One pound of good carbide should produce about 5 cubic feet of acetylene.

This reaction is one of extreme rapidity, and is in consequence always accompanied by heat, and this heat, while not affecting the carbide itself, tends to polymerize the acetylene into tar, which coats the carbide and checks the further generation of gas. In any generating chamber in which the above reaction may take place, it is therefore very desirable that the water shall always be in excess, as a safeguard against excessive heat.

4. *Nature of Acetylene.*—Acetylene once set free ranks simply as an inflammable, moisture-laden, somewhat impure, illuminating and heat-giving gas which has to be dried, purified, stored and led to the place of combustion; it is in this respect precisely analogous to coal gas, like which when mixed with air in certain proportions it is explosive. To obtain an explosive mixture with air, coal gas has to be present as 7·9 per cent. of the volume of the mixture, acetylene and air are explosive when the former is only 3·35 of the volume.

Digitized by Google

It is therefore of the utmost importance to prevent leaks of acetylene, and to guard against any explosive mixture being formed in the pipes or generating apparatus.

Acetylene is soluble in many liquids, of which an exhaustive table is given on page 179 of the work already referred to, and it is therefore important that the liquid seals of the generating apparatus shall be such that acetylene is soluble to the least degree attainable, the best of all being a saturated solution of calcium chloride.

Acetylene, as ordinarily prepared, is a powerful toxic poison chiefly on account of the sulphuretted hydrogen and phosphine present, and it has moreover, unless perfectly pure, an exceedingly penetrating and unpleasant smell.

A well-designed generating plant should, however, produce acetylene sufficiently pure to have no worse a smell or greater toxic action than ordinary coal gas, and acetylene is superior to coal gas in that it is said not to vitiate the atmosphere nearly to the same degree.

Copper should never be used in connection with acetylene, as it reacts on this metal to a marked and dangerous degree.

5. *Waste Products.*—The waste product or sludge consists of lime more or less impure. It is easy to remove from the apparatus while still wet, but once it is allowed to dry it hardens and can only be removed with difficulty, and this should never be allowed to take place. It is said that the sludge can successfully be used in mortar for building purposes, or for the lime washing of outhouses and cattle pens or as a garden manure, but no case of such use can be quoted here, the sludge generally being treated as useless and thrown away.

6. *Generators.*—Acetylene generators may be classified under two distinct heads, "Non-automatic" and "Automatic," which, in turn, may be of two distinct types, "carbide to water" and "water to carbide."

In the non-automatic type the whole of the carbide put into the apparatus is decomposed into acetylene and sludge as soon after the charge is inserted as is natural in the circumstances, and the gas is stored until required for use. On the other hand, in the automatic type the fundamental idea is that acetylene shall only be produced in response to a demand for gas and that when the flow of gas through the mains ceases, generation of gas shall also cease. The former type of apparatus necessitates a gas holder sufficiently large to contain all the gas that may be required before the next charge of carbide is inserted and more gas made, while in the latter type the gas holder need only be sufficiently large to equalize the pressure in the pipes. Each type has its merits and may be employed according to local conditions, the automatic plant being more convenient for small installations, while a very large plant such as that required for a public supply is certainly better if non-automatic.

The chemical reaction of carbide and water may be brought about in two ways, (i.) by adding carbide to the water, or (ii.) by adding water to carbide, these being the principles of the two types that bear these names. Since water is a liquid, it is more convenient of the two substances to control with the regularity required, at any rate, in the automatic plant; while on the other hand carbide is usually obtained in

Digitized by Google

lumps of irregular size and shape, which alter directly moisture attacks them and produce a damp muddy mass which it is manifestly more difficult to feed by mechanical means and yet keep under perfect control. Assuming, however, that these mechanical disadvantages have been successfully overcome, the plan of adding carbide to water will always ensure water being in excess, and this has already been shown to be the more desirable state of affairs. In the water-to-carbide type of generator means should be provided to ensure that water shall be in excess in the actual place where the decomposition of the carbide takes place.

7. *Manufacture of Acetylene.*—The various methods of generating acetylene are fully discussed, and many different plants described in the work referred to at the beginning of this section. It will therefore suffice only briefly to describe the various stages of its manufacture.

A generator usually consists of a compartment or compartments in which water and carbide are allowed to react on one another and produce acetylene. The acetylene then passes through the condenser or washer and thence into the pressure regulating holder, from which it flows to the pipes through the purifier. For the reason that a purifier will naturally act best when the gas is passing at a uniform rate, instead of by rushes as it does from the generating chamber, the proper place for the purifier is, as stated, after the regulating holder. It is indispensable that all acetylene plants should be provided with a safety valve, in the form of a vent pipe open to the outer air, that will enable the gas in the holder to pass harmlessly away should generation for any reason still proceed after the consumption has ceased.

It will be seen from the above that acetylene plants are simple, easy to maintain and require no further attention, than cleaning out and recharging when required. They contain no engine or moving parts liable to get out of order, and automatic plants reasonably cared for are moreover always ready to produce gas when wanted and do not require starting or stopping by other agency than the turning on and lighting of any of the burners attached to the system.

8. *Siting of Plants.*—Acetylene plants on account of the inflammability of the gas should invariably be installed in an outhouse or shed away from the main building, which should never in any circumstances be entered with a naked light or when smoking. All artificial lighting, when necessary, should be from the outside in a similar way to the lighting of a magazine.

In dimensions automatic plants vary according to pattern and capacity but except in cases of unusual size may generally be comfortably housed in a room not exceeding 10′ × 10′.

9. *Illuminating Power.*—In light giving powers per given volume acetylene is far superior to coal or other gas. While 1 cubic foot of coal gas per hour will under the best conditions with a mantle only give 20 candle-power, acetylene burnt at this rate in an open flame will give a light of from 30 to 50 candles, and with a mantle 140 candles is said to have been reached. Acetylene, moreover, burns with a luminous flame without smoke, and is in this respect superior to any other flame illuminant in common use.

Digitized by Google

10. *Pipes and Fittings.*—The pipes required to bring acetylene up to the burner are on the above account much smaller than those required for coal gas, and may be from $\frac{1}{4}$ in. upwards in size.

Pipes and fittings must be of the very best workmanship and material, and better and more carefully laid than is necessary in the case of coal gas.

The pressure required at the burners may be taken as 4 in. of water column as a maximum, and to ensure this a pressure of 12 in. in the generator should always be sufficient.

The burners employed with acetylene are of special design and are made in sizes to burn $\frac{1}{2}$ or 1 cubic foot per hour. The orifices for the egress of gas are very small and in order to prevent these small holes being choked with carbon deposit the burners are so arranged that the actual flame cannot reach the orifice itself. Acetylene may also be employed with the incandescent mantle, as referred to above, but is not commonly so used.

11. *Suitability of Acetylene.*—Acetylene, although not more expensive to install than air gas, is undoubtedly more costly to maintain and cannot be considered as altogether suitable for lighting barracks.

The light given is, however, a very steady and pleasing one and produces little heat; it is therefore very well suited to private houses, and places where artistic effect is of any importance.

12. *Costs.*—A small acetylene plant at Tidworth cost complete £42 for 21 lights of 24 candle-power each, or £2 per point, while a larger plant at Longford Barracks comprising 250 lights aggregating 4,245 candle-power cost to install £800, or £3·2 per point.

The plant at Tidworth is said to cost 7·7 pence per 1,000 candle-power hours, while the following figures are given for the plant at Longford for one year:—

95	10-c.p.	burners for	99,036	burner hours or	9,90,360 c.p. hours.
66	15-c.p.	,, ,,	51,074	,, ,,	7,66,110 ,,
44	20-c.p.	,, ,,	58,174	,, ,,	11,63,580 ,,
25	25-c.p.	,, ,,	32,408	,, ,,	8,10,200 ,,
15	30-c.p.	,, ,,	73	,, ,,	2,190 ,,
11	40-c.p.	,, ,,	1,340	,, ,,	53,600 ,,
					37,86,040

The costs for one year are given as—

	£	s.	d.
Carbide 9·27 tons at £16 per ton	148	6	3
Sundries	2	1	3
Labour at 6d. a day	9	2	6
Maintenance pipes	4	0	0
,, burners	5	12	0
Interest on capital	22	0	0
Depreciation	17	10	0
Total	£208	12	0

Digitized by Google

This works out at about 1s. 1d. per 1,000 candle-power hours. Figures were also obtained from the Railway workshops of the Great Western Railway at the Severn Tunnel Junction which show that for about 3,780,000 candle-power hours per annum 7¼ tons of carbide are required or 7·6d. per 1,000 candle-power hours for carbide alone, the cost including interest, labour and depreciation at rates similar to those given for Longford being about 11½d. per 1,000 candle-power hours.

It may therefore be said that acetylene will not cost much under 1s. per 1,000 candle-power hours to maintain, while the initial cost may be anything between £2 and £3 per point. Where mantles are employed with acetylene the cost per 1,000 candle-power hours can be reduced to about 8d.

13. *Flares.*—Acetylene is also used to a great extent in flares for the lighting of large areas and open spaces, and many portable and convenient forms of such apparatus are now on the market, giving light up to 2,500 c.p. a piece, and said to cost only 4d. per hour to work.

14. *Searchlight.*—A portable searchlight has lately been brought out by Messrs. Chance Bros., of 148, Edmund Street, Birmingham, in which acetylene and oxygen are employed.

The plant (known as the Sunrob Portable Searchlight) comprises the following fittings, inclusive of one hour's charge :—

Name of Part.	Weight.
Projector complete with lamp and reflector ...	34½ lbs.
Lense 30°	5½ „
„ 10°	4½ „
Oxygen generator	14¼ „
Kneeling board for directing	5¼ „
Rods for elevating and traversing	3½ „
Tripod	9½ „
Accessory Box with tools	2½ „
Tubes, rubber (2 in number)	1¾ „
Pump	1 „
Total	82¼ „

Charge for one hour's run—

Acetylene charge each	$0\frac{3}{16}$ lbs. 8d. each.
Oxylithe „ „	$1\frac{14}{16}$ „ 4s. 9d. each.
Average say ...	3 lbs. complete charge.
Total weight with 1 charge ...	85 lbs.

The body of the projector is constructed to carry two types of burners :—

(1). Single batswing burner for acetylene only.

(2). Zirconia disc in conjunction with oxy-acetylene.

The latter gives a more powerful light said to be equivalent to a 10-ampère electric arc produced in a projector of similar size. The life of the zirconia disc is said to be somewhat uncertain and renewals cost 6s. each.

Digitized by Google

The lamp which only weighs 85 lbs. complete with one charge is very portable and may be traversed and elevated from under cover, by means of the rods supplied.

The price is £110 complete, and the plant costs about 6s. an hour to run, exclusive of labour, depreciation and interest.

D.—OIL.

1. *General.*—Lighting by oil is one of the oldest methods of artificial illumination, and dates back to very early times. Various kinds of animal and vegetable oils have in the past been employed, but at the present time oils other than kerosene or other products of petroleum are only used to a limited extent. Kerosene, which is one of the heavier distillates of petroleum and has a specific gravity of about 0·810, requires a liberal supply of air for its complete combustion, and is employed in many different forms of lamp.

2. *Wick Lamps.*—The oldest and commonest form in general use is that in which oil is brought to the burner by the capillary action of a wick. Such lamps may be of the circular, single, and double wick, or of the Argand type, which on the whole is perhaps the most satisfactory.

The Argand principle can be applied to the ordinary upright burner, in which case a tubular wick is supplied with air by a central air passage, the air being forced into intimate contact with the oil vapour from the wick by means of a diffuser. This principle is also adapted to inverted lamps designed to give a more powerful light and their action may be said to be substantially the same as that of the regenerative gas burner described in Section A.

Oil lamps of the above types consume about 45 to 50 grains per candle-power hour, while with kerosene of specific gravity 0·800 is equivalent to from 1,120 to 1,244 candle-power hours per gallon. With kerosene at 6d. per gallon, 1,000 candle-power hours will cost from 5·35d. to 4·8d., exclusive of depreciation and upkeep of lamps, labour and renewal of wicks and chimneys, or say from 8d. to 9d. inclusive of these.

Oil lamps require a considerable amount of labour to keep clean, and are seldom so well kept in barracks as to burn at their highest efficiency. The cost per given amount of light including labour, depreciation, maintenance and in efficiency is therefore almost impossible to exactly determine but is certainly something more than the above figures.

3. *Mantle Lamps.*—Lamps are also made to burn oil efficiently under an incandescent mantle, the earliest form of such a lamp being the Kitson system. In lamps of this class the oil is contained in a strong tank under a pressure of about 50—60 lbs. to the square inch, and is injected through a fine tube into a chamber where it is heated by the waste heat of the lamp itself. The vapour thus produced is forced out by its own pressure through a small jet into an atmospheric burner when it draws in sufficient air to ensure its complete combustion with a non-luminous flame.

Incandescent oil lamps are made in two general forms known as the "System" or "Installation" and the "Self-Contained." In the former case several lamps are supplied with oil from one central tank by means

Digitized by Google

of fine bronze or copper tubing, it being claimed by makers that as many as 500 lamps can be supplied from the one tank or set of tanks. The latter form carries in its own oil tank sufficient oil for 16—24 hours burning. These lamps require to be started by warming up the burners until hot enough to vapourize the oil, the usual method employed being by burning a measured quantity of spirit in a cup fitted to the lamp for the purpose. It is claimed that in 1½—2 minutes the burner will be sufficiently hot and the oil may be turned on.

These lamps are made in sizes from 300 to 1,000 candle-power each, and cost from £5 for a small "Installation" lamp complete with tank and pump, to £9 10s. for a large "Self-Contained" pattern. It is claimed that with these lamps, including renewal of mantles and labour, 1,000 candle-power hours cost under 1d., a claim which may reasonably be taken as not far from the truth, if depreciation and interest be excluded.

4. *Flares.*—Another type of lamp burning oil, of which a well-known form is the Wells Light, is somewhat similar to the above which indeed is but a modification of it suitable to the requirements of a mantle. In this lamp oil is forced from a tank by a pressure of air of about 20 lbs. to the square inch into a casing surrounding the burner. The oil is here vapourized and forced out through a jet into the combustion chamber where it draws in the air required and burns with long solid luminous flame sometimes as much as 3 ft. in length and having an illuminating power up to 3,500 candle-power. This lamp also requires to be started by heating the burner, which may readily be done by burning a piece of waste soaked in oil.

These lamps, which are self-contained and weigh from 30 to 350 lbs full, are only suitable for illuminating large areas out of doors, and for this purpose their use at the present day is well recognized. Lamps of this type, which vary in price from £7 7s. to £17 15s. according to size, will give from 500 to 3,500 candle-power with a consumption of oil of about 1 gallon per 1,000 to 1,200 candle-power hours, which is much the same cost as that of the ordinary oil lamps already discussed.

5. *Oil Gas.*—Oil gas has been used as an illuminant from the earliest times both in the form of the natural product as it comes out of the ground, or as manufactured by the retorting of oil. It is not, however, in common use except for special purposes such as the lighting of railway carriages, ships, buoys and lighthouses, for which it is particularly suitable on account of the fact that it suffers less deterioration from compression than any other form of gas. Oil gas is also used for the enrichment of coal gas. A description of its manufacture is therefore out of place in this report, but further details may if required be found in *Petroleum and its Products*, by Sir Boverton Redwood.

E.—Mineral Spirit.

1. Besides air gas which has already been dealt with in Section B, mineral spirit is used in a variety of forms of lamps for illuminating purposes, from the small domestic hand lamp to the costermonger's outdoor lamp of tin.

Digitized by Google

2. In general principles the reservoir is filled with an absorbent material into which only as much spirit as can be absorbed is poured. The spirit is vapourized and burned at a jet either with or without previous admixture with air, according to the type of lamp used.

A simple form consists of a reservoir from which a tube extends downwards terminating in an Argand burner. The vapour, from the saturated contents of the reservoir being heavier than air, flows downwards under sufficient pressure to draw in the air required and burn with a steady flame.

Lamps of the above nature are suitable for domestic and other uses, but are not well adapted for use in barracks.

3. A useful and efficient form of vapour lamp suitable for domestic use is known as the "Petrolite" lamp which requires petrol of specific gravity 0·680. This lamp is similar in principle to the above, but is provided with a long glass chimney to produce a sufficient draught to draw up air through the saturated absorbent contents of the retainer to the burner. The resultant mixture is then mixed with the further amount of air required and is burnt under an incandescent mantle. These lamps are safe, as if the chimney is broken or the lamp upset, the necessary draught is then cut off and the light goes out. Their cost amounts to about 5d. per 1,000 candle-power hours.

4. Another but different form of mineral spirit lighting is that known as "Simpetrol System A," which is suitable for small installations up to about 10 lights, and is more or less portable.

This system is similar to that already described under Section D, paragraph 3, with the exception that petrol is used instead of oil. The petrol forced by air pressure in the tank passes through a fine copper tube to a coil over the burner, where it is heated and vapourized, and then burned under a mantle in a Bunsen burner.

A plant of this make consisting of 4,300 candle-power lights installed in a Sergeants' Mess at Tidworth has given no trouble. The initial cost was £18, and it is reported to cost 1·1d. per 1,000 candle-power hours to maintain.

Digitized by Google

APPENDIX I.

COMPARATIVE TABLE OF APPROXIMATE COSTS OF VARIOUS ILLUMINANTS PER 1,000 CANDLE-POWER HOURS.

Electricity at 4d. per unit.
Coal gas at 3s. per 1,000 cubic feet.
Petrol at 10d. per gallon.
Carbide at £16 per ton.
Kerosene at 6d. per gallon.

	Pence.	Smallest Unit in Candle-Power.
Electric flame arc	1	*
Incandescent high-pressure oil	1¼	300
Incandescent high-pressure gas	1½	60
Petrol air gas	1½—2	25
Incandescent low-pressure gas	3	30
Electric open arc	3	*
Electric closed arc	4	*
Petrolite vapour lamp	5	40
Tungsten electric glow lamp (metallic) ...	5	32 at 220 volts.
Regenerative gas burner	5½	100
Alternating arc lamp	6½	...*
Tantalum electric glow lamp (metallic) ...	7½	22 at 220 volts.
Acetylene incandescent mantle	8	70
Oil lamp	8—9	Variable.
Argand gas burner	10	10
Acetylene flame burner	12	15
Flat flame gas burner	14	10
Carbon filament electric glow lamp ...	14½	5

* The candle-power given by an electric arc is not exactly determinable, being dependent on point of view, shading and other variable factors. The minimum candle-power from an unshaded arc lamp may be taken at about 250 c.p.

APPENDIX II.

BOOKS CONSULTED.

"Petroleum and Its Products," Sir Boverton Redwood: published by Griffen & Co., 1906.
"Acetylene, Its Generation and Use," Leeds and Butterfield: published by Griffen & Co., 1910.
"Petrol Air Gas," Henry O'Connor: published by Crosby, Lockwood & Son, 1909.
"The Art of Illumination," Louis Bell: published by Constable & Co., 1903.
"Service Chemistry," Lewes & Brame: published by Glaisher, 1906.
Cantor Lectures—Modern Methods of Artificial Illumination delivered by Leon Gaster, A.M.I.E.E., 1909.

FIRMS AND INSTALLATIONS.

Coal Gas.

Aldershot Gas Works.
Bland Light Syndicate, 29, Little Trinity Lane, Queen Victoria Street, London, S.W.
Webb Lamp Co., Ltd., 11, Poultry, London, E.C.
Humphrey & Glasgow (Carburetted Water Gas), 38, Victoria Street, London, S.W.

Digitized by Google

Air Gas.

Machine Gas Co., Welsbach House, Grays Inn Road, London. (Installations in barracks at Tidworth, Fort George and Lydd).

Strode & Co. (Aerogen), 67, St. Paul's Church Yard, E.C. (Army Accounts Building, Aldershot).

Non-Explosive Gas Co., 13*a*, Commercial Road, Pimlico, London, S.W. (Private installation near Oxford).

Loco. Gas Co., 15, Newman Street, Oxford Street, London, W.

Drake & Gorham, 66, Victoria Street, London, S.W.

National Air Gas Co., 18, Buckingham Palace Road, London, S.W. (Concert hall at Tidworth).

Centenary Gas Co., 109, Hope Street, Glasgow. (Gymnasium at Tidworth).

North British Plumbing Co. (Mitchellite), 15, Carteret Street, Westminster, London, S.W. (Institute at Tidworth).

British and Colonial Lighting Co. (Simpetrol System C), 216, Tottenham Court Road, London, W. (Barracks at Bordon Camp).

Praed Safety Gas Co., 20, Victoria Street, London, S.W. (Barracks, Fort George, Inverness).

Victor Gas Machine Co., 358, Cathedral Street, Glasgow.

Mercury Safety Gas Co., 140, Bath Street, Glasgow.

Safety Gas Co., 117, Middlesex Street, London, E.C.

Litz Safety Gas Co., Victoria Works, Great Malvern, Worcestershire.

Acetylene.

Thorne and Hoddle (Incanto System), 151, Victoria Street, London, S.W. (Installation near Sandhurst).

Allen & Co., 106, Victoria Street, London, S.W. (Loco. sheds, Severn Tunnel Junction, G.W.R.).

Acetylene Corporation, 49, Victoria Street, London, S.W.

Wakefield & Co. (Carbic Light), 27, Cannon Street, London, E.C.

Imperial Light Co., 123, Victoria Street, London, S.W. (Installation at Dalwhinnie, N.B.).

Chance Bros.' Lighthouse Works near Birmingham. Sunrob Portable Searchlight. (Trial Plant at S.M.E., Chatham).

Oil.

A. C. Wells & Co., 102, Midland Road, St. Pancras, London.

United Kingdom Lighting Trust (Kitson: Empire and Washington Patents), 231, Strand, London, W.C.

Mineral Spirit.

Petrolite, Ltd., 202, High Holborn, London, W.C.

British and Colonial Lighting Co. (Simpetrol System A), 216, Tottenham Court Road, London, W. (Sergeants' Mess at Tidworth).

Digitized by Google

REVIEW.

MILITARY HYGIENE AND SANITATION.

By Colonel Melville, R.A.M.C.—(Edwin Arnold, 1912. 12s. 6d.).

This book is founded on lectures delivered by the author while Professor of Hygiene at the Royal Army Medical College. It is primarily intended for medical officers, but contains much on physical training, marching, equipment, and other subjects that should be of interest to all officers. Engineer officers may learn something from the chapters on water supply, ventilation, barracks, and so on.

An interesting feature of the book is the particulars as to the practice of foreign armies. It gives the medical view of questions such as the construction of barracks, water supply, sewage disposal, and others in which medical and engineer officers are concerned jointly. Officers not of the R.A.M.C. will not always agree with what is said on matters within their own province; in a book of over 400 pages there are naturally numerous points of detail open to comment. But the author recognizes that the army exists to defeat an enemy, and that military sanitation is not an end in itself but one out of many means of increasing the prospect of success. Perfect health in an army is no advantage if its preservation prevents the performance of the army's work. A corollary is that the first duty of a medical officer is to look after the healthy efficient man; the treatment of the sick is a secondary matter. A hospital full of sick men condemns the medical officer in charge of the healthy. Another is that sanitation is a matter of proportion, a form of insurance in which the premium asked may be out of proportion to the advantages offered. Where public money is concerned there is a temptation with a view to theoretical perfection to recommend expenditure which no private owner would consider for a moment. But the spirit that has come over the Army in recent years appears repeatedly in the book; success in the field is the aim and the business of the R.A.M.C. as of every other branch of the Service. Being intended for medical officers, parts of the book must necessarily be expressed in very technical phraseology. But nine-tenths of it is intelligible to laymen, and it is a pity that in such a large proportion of the book the author has not avoided the unnecessary use of medical terms. Had he done so the book would have appealed to a wider circle of readers and might have been recommended with more confidence to all officers.

A.M.H.

Digitized by Google

NOTICES OF MAGAZINES.

REVUE MILITAIRE DES ARMÉES ÉTRANGÈRES.

December, 1911.

THE CHINESE ARMY IN SPRING, 1910.—In 1906 plans were formulated for the reorganization of the Chinese Army, according to which this force should consist at the end of 1912 of 36 divisions and one guard division. At the beginning of 1911 the actual strength of the army was 175,000 men, out of a theoretical total of 220,000, divided as follows:—13 complete divisions and 19 mixed brigades, or in other terms, 260 battalions, 58 squadrons, 171 batteries, 72 companies of sappers, 66 transport and supply companies, 169 machine guns. The increase since 1910 was 32,000 men. Training is steadily progressing, but *esprit de corps* is somewhat lacking. The reserves of this army are at present existent on paper only and the transport and supply services and the arsenals leave much to be desired, China is entirely dependent on the foreigner for military uniforms and equipment, and the existence of large reserve supplies of ammunition is problematic. The chief trouble is the absence of a definite grant of funds to the army; the viceroys are mainly to blame for this, as they fail to produce the money from their provinces for the soldiers who are quartered in them.

January, 1912.

MILITARY NEWS OF DIVERS COUNTRIES.—*Italy.*—A consulting committee, consisting of a lieutenant-general as president, six members of parliament, four military and three naval officers, and the presidents of the Italian aero and the touring club, has been formed to assist the War Office in matters referring to the science of navigating the air.—As a result of the war, the forces of the Italian army have been increased by 24 battalions of infantry, 3 rifle battalions, 5 squadrons of cavalry, 6 field artillery batteries, 12 mountain artillery batteries, 12 companies of fortress artillery, and 6 companies of engineers.

February, 1912.

THE NEW BRIDGING EQUIPMENT OF THE GERMAN ARMY.—A German engineer officer points out the following advantages in a report on the new bridging equipment:—(1). It renders the whole equipment of the German Army in bridging *matériel* uniform, hitherto the Bavarian and Prussian Armies had different types of equipment. (2). The new *matériel* has greater capacity, better stability, a more simple construction, and greater mobility than the old. (3). The boats can support 6,000 instead of 4,000 kilogrammes. (4). The new pontoon can carry 18 armed men, besides those rowing, the old could only carry 12. (5). The new material allows of a bridge 200 metres long, which will take heavy howitzers, being built for every army corps.

A. H. SCOTT.

Digitized by Google

Rivista di Artiglieria e Genio.

April, 1912.

Military Photography from Aeroplanes and Dirigibles.—Aerial locomotion will exercise a great influence on military operations, because, apart from its offensive value (by dropping projectiles from above), it will be of the greatest importance for reconnaissances—both strategical and tactical. Everything however depends upon the eye and the memory of the observer, who, if acting as pilot at the same time, is probably less quick in grasping and retaining in his memory the details of a military situation. This necessitates the employment of photography for purposes of reconnaissance. But in order that it should succeed, circumstances and the machines in use for the flight, etc., should be carefully taken into consideration, and it is not sufficient to take on board any kind of photographic apparatus as the negatives obtained would show insufficient or too bright images, and the camera itself would not be easy to manage and would be more of an encumbrance than of use.

Aerial military photography may either be used for taking rapid views of the ground—by taking a collection of photographs with horizontal plates and uniting them so as to form one plan—or it may be used for taking panoramic views, in which case the plates will not be horizontal. Taking photographs from an aeroplane will present greater difficulties than taking them from an airship owing to its greater velocity and less available space.

It is essentially necessary to fix the scale of reduction, and for military purposes a scale between $\frac{1}{5000}$ and $\frac{1}{10000}$ is convenient: in fact with the last scale trenches of only 1 metre may be seen with lines of $\frac{1}{10}$ of a millimetre in thickness. It follows therefore that from aeroplanes at a height of 1,000 to 1,200 m.—since at a lower elevation they would run the risk of being struck by rifle bullets and at a higher elevation the observations would be indifferent especially if the aviator is alone—the objective should be from 12 to 16 c.m. At 1,200 metres of height an objective of 12 c.m. would give a reduced scale of $\frac{1}{10000}$, and one of 16 c.m. a scale of $\frac{1}{7500}$; the last with a plate 13 × 18 would reproduce a zone of ground of 975 × 1,350 m. So that with an apparatus 13 × 18 with an objective of 16 c.m., with 12 maps taken horizontally a stretch of ground 1,350 m. in width and 10 k.m. in length can be portrayed in the few minutes required to traverse such a distance.

A photographic apparatus called the Ortho-Protar Zeifs, by which instantaneous pictures can be taken, is described with the following characteristics:—Size 13 × 18. The aviator can control the movement of the shutter and change of plates by pressing a button.

The photographic apparatus, in monoplanes, will be placed in such a position as to have freedom of view, and so that the optical axis may be as far as possible vertical. The vibrations of the motor are obviated as far as possible by elastic cushions. The observer must have both his hands free to be able to take the photographs, to change the plates, etc.

In the case of photography from a dirigible the altitude should be not less than 2,000 m. so as to be beyond rifle fire. To maintain the same

Digitized by Google

relation of reduction in the picture of the ground beneath the line of route, an objective varying from 20 to 30 c.m. should be adopted and it is convenient to use an apparatus 21 x 21. The camera will be of a trunco-pyramidal form suspended outside the car and furnished with an automatic shutter. With a camera of this kind at a height of 2,000 m. with an objective of 20 c.m., if a 21 x 21 plate be used with an area of ground 2,100 metres in width can be taken at a scale of $\frac{1}{10000}$ and dozens of plates can be used in a day. There is in fact no limit to the number of negatives that can be taken on board a dirigible.

For developing the usual materials give good results when the temperature is not too high, but those in which glycerine is little used give the best results. For developing in the summer, under a tent, or on board ship at a high temperature, the plates should be kept for five minutes in a solution of formaline of 5 per cent. and then washed.

For photography from anchored balloons the same materials may be used as those for panoramic views from dirigibles.

In the sieges of the future, small balloons carrying suspended photographic apparatus with an inclined axis will be much used for taking views of the adversary's works. They can be easily managed and can be sent up from the advanced position, and if struck by the enemy's projectiles, the loss is limited to the material.

FRANCE.—ORGANIZATION OF THE MILITARY AERONAUTIC SERVICE.—*France Militaire* of the 7th—8th April, publishes the orders for military aeronautics of last March; these comprise the *personnel* for aerial navigation, troops, and establishments.

Superintending the whole, there is a permanent Inspector-General of Military Aeronautics who corresponds directly with the War Minister. The *personnel* for navigation comprises officers and men taken from the various corps. The troops consist of: (*a*), Seven aeronautic companies; (*b*), some aeronautical sections whose number is determined by the War Minister; (*c*), 1 company for transport. These detachments can be united, the composition of the reunited detachments being established by decree.

The officers of these troops are also taken from the various corps of the army and are placed on a supernumerary or seconded list.

The following shows the composition on a peace footing of the units:—

Aeronautic Companies.—Captains 1, lieutenants and sub-lieutenants 2, total 3. Officers' horses 3. Adjutants 1, sergeants 11, corporals and privates 91, chief artificers 5, total 108.

Aeronautic Sections.—Captains 1. Officers' horses 1. Sergeants 3, corporals and privates 55, total 58. Troop horses 6.

Transport Companies.—Captains 1, lieutenants and sub-lieutenants 2, total 3. Officers' horses 3. Adjutants 1, sergeants 12, corporals and privates 114, total 127. Troop horses 130.

E. T. THACKERAY.

Digitized by Google

CORRESPONDENCE.

A FIELD DRAWBRIDGE.

DEAR SIR,

In my article in the August *R.E. Journal* on "A Field Drawbridge," I mentioned (line 3 from bottom of first page) that there was a tendency on the part of the movable portion of the bridge to creep sideways. A very simple and effective means of preventing this has been discovered, and this consists in putting a figure of 8 wire loop in a groove round the moving and the stationary transom.

There is an obvious misprint in line 16 of the same page, where "*15 ft.* behind it" should read "*3 ft.* behind it."

Yours faithfully,

E. K. MOLESWORTH,

Capt., R.E.

Bangalore, August 22nd, 1912.

The Editor, *R.E. Journal.*

"THE STORY OF JERUSALEM."

SIR,

Your reviewer's appreciative notice of Sir Charles Watson's *Story of Jerusalem* is, for many of us, marred by his treatment of the Old Testament history in its account of the slaying of Goliath. This is by no means "generally discarded" as he supposes. It may be so by the school to which presumably he belongs, and which is much in evidence nowadays, particularly in the fugitive literature of the day, but it is undoubtedly received as historical by the many who form the broad, deep, and influential stream of sound religious opinion and belief.

By making David an Amorite instead of a Semite the reviewer does not answer his author's question, "How to account for the sudden rise to greatness of the Israelite monarchy under David, and how did a simple shepherd boy obtain the influence over men which enabled him to carry his ideas into effect."

"The author should re-read his history in the light of modern biological research." That is exactly what the reading people among us are habitually doing; and we get many and highly interesting side lights on the Bible history.

Again, "The Semitic races have never produced great rulers." Well—we are concerned here with *one* Semitic race—Israel. Was Moses not a great ruler? More—was he not among the greatest? Or among minor rulers, were not Joshua, Samuel, Hezekiah, Judas Maccabeus, rulers of

Digitized by Google

note? Exclude the two greatest kings who ever reigned—for in moral and ethical importance none other approach them—from the Semitic line and it becomes easy to say that "Semitic races have never produced great rulers."

Lastly, "The subjection of the somewhat servile Semitic people to the virile and energetic Northern character" seems not to be confirmed by history. Let us quote the Tel-el-Amarna letters—"the Amarna letters tell us that the 'Abiri (or Hebrews) in the South of Palestine destroyed all the rulers" (Condor). This does not look much like "subjugation" for the Hebrews!

That David was "ruddy and of a fair countenance" may have given rise to the supposition that he was not a Semite or true son of Abraham. But the mystery of dark and fair meets us every day in our own experience. Dark parents will produce the fairest blonde. Dark and fair children are not uncommon in the same family. The fair complexion ot David may have come from his great-great-grandmother, Rahab of Jericho; and the fair strain thus (and not unlikely by other intermarriages) introduced into the Royal line may have reappeared and become a recurring feature in it.

D.C.W.

September, 1912.

The Editor, *R.E. Journal.*

Digitized by Google

PLATE I.

LOCK L-A

Days of Block shown 1 or 1/2 or 1/2

Military Train Nos shown thus (18)

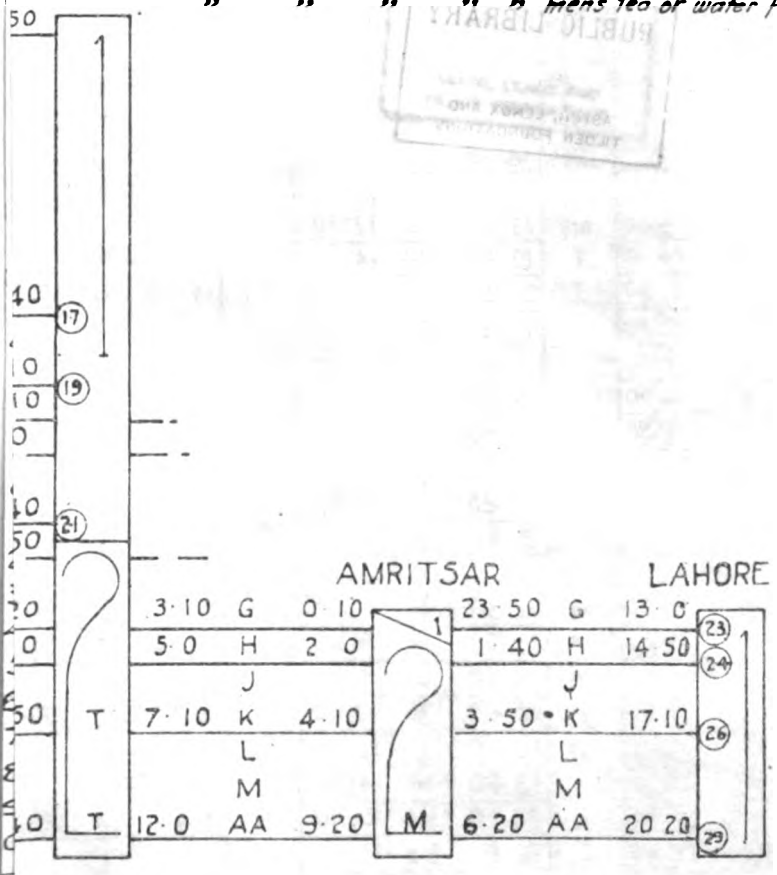
Mixed or Mail Train timings } " — — — —

Troop Train " ————————

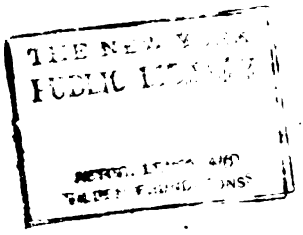
Supply Train " — · — — —

Stations where trains halt for cooked meal marked M.

" " " " " means tea or water for animals T

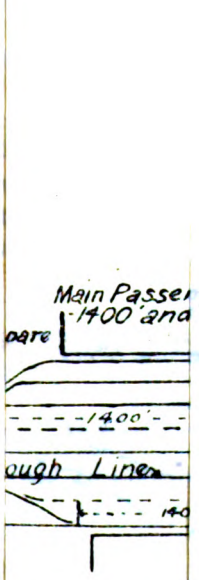


Digitized by Google



Digitized by Google

NCENTRA



THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

SHOWING

Digitized by Google

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

FIELD TROOP SUMMER TRAINING, 1912.

Compiled by CAPT. H. J. ELLES, R.E.

IT has been suggested by the Inspector of Royal Engineers that the publication in the *R.E. Journal* of the tactical-technical Schemes carried out by the 1st, 3rd, and 5th Field Troops, R.E., this year—with comments on the various points brought to notice—would be of interest to officers concerned in the training of other Engineer Field Units.

The Field Troops, R.E., do annually six weeks Summer Training in Camp. For those in England this consists of three weeks bridging and rafting practice (latterly on the Thames) by each Troop separately, and three weeks Combined Training together on "Schemes" with as much practical work as possible included.

This year the Individual Camp was just below Streatley-on-Thames. The Combined Camp was also to have been there. But the Troops were ordered by the War Office to prepare the camps in the Army Manœuvres area for the Cavalry Divisional Training, and to carry out their own Combined Training in the same area; so the Combined Camp was located at Newton, one of the Cavalry Camp sites south-west of Cambridge.

Owing partly to inclement weather, and partly to days having to be put aside for work in connection with Camp preparation and movements to Brigade Camp sites, the actual number of working days on "Training" was somewhat less than usual.

Capt. R. Hutchison, 11th Hussars, of the Directorate of Military Training, kindly came down to Newton at the commencement of the Camp, and assisted with the preparation of the General and Special Ideas.

The main points aimed at during this year's training were:—firstly, rapidity in forming decisions as to the occupation of localities and the work to be executed, and in the actual commencement of work; secondly, intercommunication between troops.

In all schemes the actual work was carried out as far as possible, *e.g.* dummy charges fixed for demolition and fuses or leads laid, tools required for works laid out, etc.

On two bye-days memory-map-reading was practised by N.C.O.'s. A sample exercise and explanations are given at the end of the Schemes. This affords a very useful exercise in map-reading and memorizing and in observation and deduction.

Digitized by Google

Reference ½-inch Manœuvre map, Southern Sheet, or 1-inch O.S. map, Sheet 85.

GENERAL IDEA.

1. BLUELAND and BLACKLAND, first-class Continental Powers, are at war on the Continent of Europe.

BLUELAND has gained control of the sea north of the ENGLISH CHANNEL.

2. REDLAND (England), an ally of BLACKLAND, is just completing her mobilization of one Cavalry and six Infantry Divisions, and is undecided whether or not this force shall be sent to the Continent to help BLACKLAND.

3. BLUELAND, in order to prevent REDLAND from sending any troops to BLACKLAND'S assistance, has invaded REDLAND with a force of one Cavalry Division, a number of cyclists, and two Corps.

These troops have landed at KING'S LYNN and are marching on LONDON.

Digitized by Google

SCHEME "A."

(i.). Rapid Reconnaissance of a Position.
(ii.). Deliberate Preparation of a Position.

Special Idea No. 1.

1. The REDLAND Government have hastily collected all available troops to drive out the invader. They have concentrated by rail in the area BEDFORD—POTTON—HITCHIN—LUTON, with the Cavalry Division about ROYSTON.

2. As far as can be ascertained the positions of the respective forces at 2 p.m. on the 1st of June are :—

(*a*). *REDLAND.*

Cavalry Division on the line ROYSTON (4th Brigade)—KNEESWORTH (1st Brigade)—ORWELL (2nd Brigade)—Headquarters at ORWELL.

Infantry columns billeted in depth with their heads at BALDOCK, ASHWELL, DUNTON, GAMLINGAY. Army Headquarters at BEDFORD.

(*b*). *BLUELAND.*

Cavalry Division and cyclists at NEWMARKET, one Corps at BRANDON, and one Corps at THETFORD (16 miles N.E. of NEWMARKET).

Patrols are reported to have been in BOTTISHAM, FULBOURNE, BARTLOW, and LITTLE THURLOW at 6 a.m.

3. At 4 p.m. G.O.C. Red Cavalry Division after a conference with Red G.O.C.-in-C., issued orders of which the following is a *précis* :—

"The Division will move forward to-morrow and make good the high ground between GUNNERS HALL, two miles N.E. of LITTLE ABINGDON, and CHERRY HINTON.

"The Division will march in three columns, which will move *viâ* TRUMPINGTON, GREAT SHELFORD, and WHITTLESFORD. Each column will furnish its own advance guard, which will be accompanied by a Field Troop.

"On arrival on the above-mentioned line the Field Troops will strengthen the position WORSTED LODGE—RESERVOIR under instructions from the C.R.E."

Digitized by Google

The following special instructions were issued to the C.R.E. by the G.O.C. :—

"As soon as the advanced guards have got beyond the line WORSTED LODGE—RESERVOIR, I want you to reconnoitre this line and report :—

"(i.). How it can best be strengthened.

"(ii.). What working parties you will require to assist you.

"The time available for the work will probably be about six hours; and the Division will hold the ground for 24 hours until relieved by the Infantry, who will occupy the ground with the strength of one Division."

Exercise (*A*).—C.R.E. will issue preliminary instructions to O.C.'s Field Troops, which are in billets allotted to Brigades.

Exercise (*B*).—C.R.E. will report as instructed by G.O.C.

Exercise (*C*).—Cavalry will be allotted to assist in the preparation of the line, tasks assigned, and sappers distributed for work and supervision.

Exercise (*A*).—C.R.E. issued the following instructions to O.C.'s Field Troops by Troop cyclist orderlies attached to Headquarters :—

"The Field Troops will strengthen portions of the position referred to in Divisional Orders as follows :—

"*5th Field Troop.*—WORSTED LODGE—COPLEY HILL, exclusive.

"*1st Field Troop.*—COPLEY HILL inclusive—road junction at POINT 22 exclusive.

"*3rd Field Troop.*—POINT 22 inclusive to RESERVOIR.

"Each O.C. Troop will reconnoitre his section and report—

"(i.). How it can best be strengthened.

"(ii.). What working parties and extra tools he will require, on the assumption that about six hours are available for the work. The Cavalry will hold the position for 24 hours until relieved by Infantry. The dispositions should be such that the arrangements are capable of expansion for the line to be held by one Division of Infantry.

"O.C.'s will hand in reports personally at COPLEY HILL as soon as possible after 1.30 a.m."

The scheme was so timed that about one hour was available for O.C.'s Troops to make their reconnaissance and the C.R.E. to prepare his report before the supposed arrival of the G.O.C. at COPLEY HILL. The line taken up presented no particular difficulties. The C.R.E. was able himself to make a cursory inspection of about two-thirds of the line in the allotted time.

Digitized by Google

COMMENTS.

(1). The necessity for punctual report at the rendezvous was not realized in every case. In the time given the C.R.E. was not able to make a thorough reconnaissance of the line himself, and for certain portions of the line he had to depend entirely on the reports of his subordinates. From their reports, combined with his own observations, the C.R.E. would, in such a case, advise the G.O.C. on the points mentioned in his special instructions. The G.O.C. would then give orders for the detailing of working parties as far as the tactical situation would permit. If, however, the reports were not up to time, as actually happened in this instance, there would be considerable danger of all the Cavalry passing the line and of the C.R.E. having to carry out his suggestions without any working parties at all. This of course might happen even if the reports were in time, if the tactical situation demanded it.

(2). In the orders to the G.O.C. Cavalry Division, issued by the G.O.C.-in-C., the phrase used with regard to this line was "The Cavalry will make good the line." This phrase was taken to mean that the Cavalry would operate well in front of the line and not plant themselves on the line itself. Exercises (A) and (B) therefore resolved themselves into, firstly, a reconnaissance, and secondly, the employment of the Field Troops up to the time when the line would be definitely settled by the C.R.E. and such working parties as had been given him by the G.O.C. had been distributed to sections. Up to this time the Sappers of the Field Troops could be employed in collecting tools and materials and making a detailed inspection of localities that would probably be used.

In Exercise (C) it was supposed that one regiment was allotted for strengthening the whole line, and the C.R.E. allotted one squadron from that regiment to each of the three sections. No material alteration was made to the line suggested by the three O.C.'s Troops.

(3). Some difficulty was experienced by O.C.'s Troops in meeting each other at the ends of their sections for the purpose of connecting their flanks. After considerable discussion on this point, it was decided that the most effective way of overcoming this difficulty was for each O.C. Troop to place one man at each end of his section, to act as a post-office for messages, and to guide officers and orderlies to their Troops. The O.C. Troop would start reconnoitring his section from one flank, and drop an orderly at that flank with instructions as to how that flank was to be occupied. He would send an orderly to the other flank to get similar information from the officer in charge of the next section. Each of these orderlies would be informed of the probable whereabouts at certain hours of his own O.C.

Digitized by Google

(4). When two or more officers are called upon to report on sections of a defensive position or other locality, and they are required to or are likely to submit sketches or enlargements from a map, the C.R.E. (unless some permanent understanding on the point exists in his command) should give instructions as to whether the sketches should be drawn with two edges of the paper true north and south or whether they should be drawn with edges parallel to the supposed line of the enemy's advance; unless this is done a variety of orientations will result, and it will be impossible to piece the sketches together so that they can be read as one. In the case of a *line* being reconnoitred, it seems most convenient for the sketches to be drawn with two edges running north and south and with place names east and west, as in a map, while the information *re* allotment of troops, position of machine guns, etc., etc., is entered so as to read when the sketch is held facing the enemy; the sketch can then be easily compared with the map and yet be conveniently read with reference to the tactical problem. In other cases, the sketches would usually be best made exactly as a map.

As War Diaries apparently require to be accompanied by copies of all reports, messages, orders, etc., officers should accustom themselves to making all sketches in duplicate.

(5). The tools of Cavalry regiments are carried in a limbered G.S. wagon with signalling equipment. In cases of this sort, where the occupation of the line is contemplated overnight, some arrangement should be come to with Divisional Headquarters for brigading the tools of a brigade, so that the tools can be fetched up without delay.

Digitized by Google

SCHEME "B."

Night Raid on Hostile Railway Communications.

SPECIAL IDEA NO. 2.

In addition to the orders and instructions referred to in Special Idea No. 1, paragraph 3, the following was also issued confidentially :—

"The C.R.E. will detail three parties of Engineers, which will leave to-night with escort of one Squadron each from the 1st, 2nd, and 4th Brigades, and move and act as follows :—

"(1). From 1st Brigade (ROYSTON) *viâ* NEWTON, and south-east of NEWMARKET-ABINGTON ROAD, and destroy the railway between SIX MILE BOTTOM and NEWMARKET.

"(2). From 2nd Brigade (KNEESWORTH) *viâ* NEWTON and south and east of CAMBRIDGE, and destroy the railway between STOW-CUM-QUY and SWAFFHAM PRIOR.

"(3). From 4th Brigade (ORWELL) *viâ* NEWTON and west and north of CAMBRIDGE (avoiding that town), and destroy the line between FEN DITTON and WATERBEACH."

C.R.E. issued the following instructions (by Troop cyclist orderly attached to Headquarters) to each Field Troop :—

"You will send with the squadron from your brigade two parties of cyclists with demolition materials."

Exercise (*D*).—At 10 a.m. report very briefly :—

(i.). How you think the Squadron should be employed.

(ii.). At what time and by what routes you would move.

(iii.). What steps you would take to decide how, where, and when your separate parties would act.

and (iv.). Parade your parties ready equipped.

N.B.—For purposes of instruction as many parties as possible should be employed, both cyclists and mounted.

Exercise (*E*).—(i.). Carry out your march and demolitions with all your parties in accordance with the plans approved after discussion on the points raised in Exercise (D).

Dummy charges to be actually placed as far as possible.

(ii.). Report on the exercise at 3.30 a.m., on Saturday, 3rd inst., at LODE.

Digitized by Google

COMMENTS.

(1). It was agreed that when time was available, the way to carry out these distant demolitions was to occupy two nights and one day in the process. On the first night parties with their escort would proceed as near as possible to the proposed site of the demolition, and the escort would there be dropped. The demolition parties would lie concealed during the next day in some copse or building within sight (if possible) of their objective; the route would be explored (probably with field glasses), and if possible the objective reconnoitred. During the second night the demolition party would proceed on foot to execute its task, and on completion of the work would retire to their escort, which would act as the rallying point.

In this exercise the conditions were that the railways should be destroyed on the same night. The question then arose as to whether it would be better to act by force or by stealth. By "acting by force" is meant that the escort should overpower the picquets on the railway and keep off reinforcements until the work of destruction had been completed. "Acting by stealth" would mean that the escort would take the demolition parties as far as they could with a reasonable hope of not being disturbed by any formidable opposition, and that from that point the demolition parties would proceed alone and unobserved. All three troops decided on the latter method; and, generally speaking, advanced to within about three miles of their objectives, there dropped their squadrons, and proceeded on foot.

(2). The question of the timing of several demolitions was discussed on the completion of the exercise. It was agreed that, in order to get as good a result as possible, a definite hour should be fixed before which no actual demolition should take place, unless any party were interrupted. By this means the danger of one party letting off their charge before the second or third party were ready to do so would be considerably reduced. An ample margin of time must, however, be given to allow for the delays on the road which are certain to occur.

(3). Three minor points, which are of interest, arose in this exercise.

In the first place nearly all the supposed culverts and bridges turned out to be level crossings. The difference of the conventional signs on the $\frac{1}{2}$-inch map is just noticeable when the map is examined carefully in a good light.

Secondly, an observer, who was waiting on a culvert for the approach of one party, heard the horses of that party on the road at a distance of $2\frac{1}{2}$ miles; but he did not hear the party itself cross the railway in order to attack it from the rear at a distance of 400 yards. Obviously demolition parties should when possible proceed on bicycles and not on horses.

Digitized by Google

The method of attack from the rear seems very sound, as a sentry might easily take movements of a party behind him to be those of his own side.

Thirdly, one of the few culverts was of peculiar construction. The rails rested on longitudinal sleepers on chocks in trough girders, and the spaces between the rails were filled with steel or iron plate decking ; the stream under the culvert was deep water. In the pitch dark it took a considerable time to ascertain the construction of the culvert, and the fixing of charges was a difficult matter.

Digitized by Google

SCHEME "C."

(i.). Preparation of Bridge Heads.
(ii.). Hasty Reconnaissance of a Defensive Line.

NARRATIVE.

On the night of the 1st—2nd June, the attempts on the railway lines met with some slight success. Rails were removed in two places, and the small culvert 1 mile east of LODE station was destroyed.

On the 2nd June, the Cavalry Division held the line RESERVOIR-WORSTED LODGE, but were hard pressed along their front, and in the late afternoon forced back to their defensive position.

SPECIAL IDEA NO. 3.

At 11 p.m. on the evening of the 2nd June, the G.O.C. Cavalry Division gave the following confidential instructions to the C.R.E. verbally :—

"The Division will retire slowly to-morrow west of the line of the R. GRANTA. I intend holding this line from GRANTCHESTER to WHITTLESFORD, both inclusive, until the arrival of the Infantry columns, which I expect at 4 p.m. to-morrow.

"You will arrange for defence of the river crossings with the Engineers at your disposal, assisted by one regiment of Cavalry.

"No bridges are to be destroyed.

"You will also report by 10.30 a.m. on the suitability for defence of the line indicated."

The C.R.E. issued orders, of which the following is a summary, by Troop cyclist orderlies :—

"The Field Troops will prepare the defence of the crossings of the GRANTA from GRANTCHESTER to WHITTLESFORD, both inclusive, with a view to the occupation of this line on the west of the GRANTA.

"*1st Troop.*—WHITTLESFORD STATION inclusive to PAPER-MILL BRIDGE inclusive.

"*5th Troop.*—PAPERMILL BRIDGE exclusive to HAUXTON MILL BRIDGE inclusive.

"*3rd Troop.*—HAUXTON MILL BRIDGE exclusive to GRANT-CHESTER inclusive.

"A squadron of Cavalry will report to each Troop at 10 a.m. at GRANTCHESTER, GREAT SHELFORD, and WHITTLESFORD respectively.

Digitized by Google

"Bridges are not to be destroyed, but may be prepared for demolition provided traffic is not obstructed.

"O.C.'s Troops will also reconnoitre their sections, and report to me by 9.45 a.m. at HAUXTON MILL as to the suitability of their sections for occupation by a brigade of cavalry and as to artillery positions."

Exercise (*F*).—O.C.'s will reconnoitre and report as instructed in C.R.E.'s orders.

Working parties and tools will be distributed, and tasks allotted.

Exercise (*G*).—Subalterns will submit sketches of the sections of the line allotted to their Troops, showing :—

(i.). Positions selected.
(ii.). Troops suggested for occupation.
(iii.). Works proposed.

N.C.O.'s will submit sketches of localities and works allotted to them, and a statement of working parties, tools, and time.

COMMENTS.

(1). Regarded as an exercise in reconnaissance, Scheme "C" was a variation of Scheme "A." In this instance, O.C.'s Troops, in order to get their reports submitted punctually, had only sufficient time to canter and trot round the sections allotted to them. The nature of the country was such that the C.R.E. could, by the time at which his report was due at Divisional Headquarters, do no more than make a very partial examination himself and collate the reports of his subordinates. A definite hour had been fixed by the G.O.C. for the rendering of the C.R.E.'s report ; it was therefore assumed that the G.O.C.'s tactical dispositions might to a large extent be dependent on that report, and the importance of punctuality was thus emphasised.

(2). As regards the preparations for defence of the crossings, this Scheme differed from Scheme "A" in that no delay need be incurred in actually starting work, for the line indicated in C.R.E.'s orders was a very definite one, a long natural obstacle ; and the only variation possible was whether bridge heads should be constructed in front of the crossings or whether defences should be prepared in rear. The works to be undertaken were perforce isolated, and the maintenance of a connected line between these works was of secondary importance.

(3). The questions to be answered in order of importance in this case were :—

(i.). How can I best assist the retirement of our cavalry ?

(ii.). Can I make my dispositions such that, in addition to (1), I can facilitate the advance of our troops to-morrow when we expect to be reinforced ?

Digitized by Google

On examination of the ground, it was found that the decision of the question whether defences should be constructed in front or in rear of the passages was at each place entirely dependent on the locality itself. At the GRANTCHESTER crossing, for instance, the only possible line to hold was found to be the east edge of TRUMPINGTON village; at HAUXTON and GREAT SHELFORD the defensive post was slightly in front of the bridge; at WHITTLESFORD the main defence was well behind the stream.

(4). Other points which arose in the discussion on the exercise were as follows:—

Having placed the locality in a state of defence, careful arrangements must be made for leading into the positions the troops detailed to occupy them. This, it would appear, can only be done by sending officers to meet the troops on the line of retreat some distance in advance of the positions.

Considerable confusion was caused at one place by an officer issuing orders to a N.C.O. partly by word of mouth and partly in writing, with the result that his instructions were entirely misunderstood and only the written orders carried out. If, in cases where subsequent supervision is difficult or unlikely, there is not time to give all necessary instructions in writing, at least the main headings of the instructions should be clearly given in writing, and these written instructions should then be amplified by verbal explanations.

Digitized by Google

SCHEME "D."

Engineer Reconnaissance for Materials.

(Officers and N.C.O.'s).

Exercise (*H*).—The C.R.E., from a map, issued the following order on the supposition that the information collected might be useful to Field Companies later on.

"1. The Field Troops will make an Engineer Reconnaissance of the areas in CAMBRIDGE specified below.

3rd Troop.—Area bounded by :—

N.W. Gonville Place.
S.W. Hills Road.
N.E. Mill Road.
} All inclusive.

1st Troop.—Area bounded by :—

N. River Cam.
E. Victoria Avenue, Emmanuel Road, Parker Street, to south corner of Parker's Piece.
S. South boundary of Downing College.
W. The River Cam.
} Inclusive.

5th Troop.—Area bounded by :—

W. Newmarket Road.
E. G.E. Railway to Ely.
S. Mill Road exclusive.
W. East boundary of Christ's Piece exclusive.

"2. This reconnaissance has special reference to materials suitable for bridging.

"3. Troops will rendezvous at the Market Place, and O.C.'s will submit reports to the C.R.E. there at 11.30 a.m."

COMMENTS.

1. This Scheme was timed so as to give about 1½ hours in CAMBRIDGE before reports had to be given up. O.C.'s Troops were not supplied with maps of Cambridge beforehand. Two officers bought such maps on arriving in CAMBRIDGE ; the third officer did not do so, and his report was not delayed thereby. The Scheme was well carried out, and reports submitted punctually.

2. In the area allotted to the 3rd Troop, the S.E. boundary was undefinable on the C.R.E.'s map and was not defined. It turned out that on this side, beyond the Railway Station, was one of the two largest builder's yards in the town. When possible the C.R.E.

Digitized by Google

should make a personal reconnaissance before allotting areas in a large town, and areas should definitely include or exclude principal roads. (In a similar exercise at Maidenhead last year, a road which was apparently outside the industrial area was given as the boundary between two units; neither unit reconnoitred the road, and it contained the largest timber yard in the place). These reconnaissances show that a very large quantity of engineer material is to be found even in comparatively small towns; they also show that that most useful article, the beer-barrel, is to be found in large quantities, but is often overlooked.

3. The following other point was raised in a discussion on the Scheme:—

In most cases the troops were subdivided into parties of three or four, to whom areas were allotted and by whom materials of all sorts were searched for. In one case, however, materials were looked for by men according to trades, that is to say, carpenters reconnoitred only for scantlings and scaffolding, iron workers for girders, bolts, etc., and so forth. The question seems to be one of personal taste; but it is suggested that for general building materials, such as are of use in field engineering operations, all sappers should be sufficiently trained to know what is useful and what is not; whilst for special stores, *e.g.* Portland cement, girders, traction engines, and vehicles, experts should be detailed if such stores are required.

Digitized by Google

SCHEME "E."

Occupation and Defence of Close Billets.

NARRATIVE.

On the 3rd June, the Cavalry Division retired behind the line of the river GRANTA, and held that line till the morning of the 4th June. Infantry columns then began to arrive.

At 4 p.m. on the 4th June, the Cavalry Division again advanced across the GRANTA in a north-easterly direction.

SPECIAL IDEA NO. 4.

At 6 p.m. the positions of the Cavalry columns were as follows :—

	1st Bde.	2nd Bde., Divl. Headquarters, and Divl. Troops.	4th Bde.
Advanced Guards	MUTLOW HILL	FULBOURN	TEVERSHAM
Main bodies ...	WORSTED LODGE	MEGGS HILL	RESERVOIR

The 3rd Brigade was operating independently to the front.

The disposition of the Field Troops was as follows :—

Mounted men with advanced guards, cyclists and vehicles in rear of leading regiments of main body.

At 6 p.m. the Brigades were ordered into close billets at SIX MILE BOTTOM, LITTLE WILBRAHAM, and LODE respectively, with Divl. Headquarters at BOTTISHAM, Divisional Troops (less Engineers) at GREAT WILBRAHAM, and the 3rd Brigade on the line SWAFFHAM PRIOR—NEWMARKET.

Exercise (*f*).—C.R.E. issued the following orders :—"(i.). O.C.'s Troops will submit sketches showing the billeting arrangements of their Brigades, including allotment of troops, defensive arrangements, alarm posts, and water supply.

(ii.). Water supply as for a Brigade will be actually carried out.

NOTE.—Attention is drawn to *Field Service Regulations*, Part I., paragraphs 45—54."

Digitized by Google

Later on orderlies were sent to each of the Field Troops, to the billeting areas of their Brigades, with instructions that the Field Troops were to march to BOTTISHAM, and to close billet there on completion of the task allotted to them in the exercise. The Troops arrived during dusk and after dark, and billeted in a farm hired for the purpose. An alarm was sounded at 3 a.m. and the Troops turned out on their alarm posts; the time taken to turn out, ready for the road, was between twenty minutes and half an hour respectively for the first and last Troops. The night was a very dark one.

The C.R.E. and Adjutant worked out Exercise (J) (i.) with regard to BOTTISHAM itself, and other dispositions were examined and discussed on the following morning.

COMMENTS.

1. Considerable doubt exists as to the methods which should be adopted for protection of Cavalry in close billets. Regulations on the subject are, it is submitted, generally obscure, and do not appear quite to meet war methods which have not yet been put into actual peace practice in this country. It is understood that in close billets, men, as necessary, would be told off to occupy certain points in the perimeter (*e.g.* barn walls, garden hedges, farm windows), and on alarm would go to those points; the surplus would go to the alarm post of the unit, which would more properly be termed the assembly post for the local reserve. The general alarm post would appear to mean the assembly post for the general reserve, *i.e.* for the unit (if any), or the part of such unit, which was not allotted any position on the perimeter.

It is believed that the regulations are under revision. An authoritative solution of this problem by the general staff would be of great value.

2. Two points of interior economy arose during this exercise viz. method of carrying cleaning gear, and supply of canvas buckets. The best method of carrying cleaning gear is to have a small stout cloth bag (made for it under Troop arrangements), and to carry it strapped to the offside of the saddle.

Buckets are issued on a certain scale for manœuvres; they should form an article of Troop equipment at the rate of one for every two horses, and for riding horses should be carried on the saddle.

3. The disposal of rifles when in billets requires very careful attention. In close billets they would be with the men; in open billets they would be placed under a sentry in each house (see *F.S.R.*, I., paragraphs 52—54).

Digitized by Google

4. It was pointed out on this Scheme that it is quite probable that, in a case where Brigades got into either close or open billets in a Brigade area, a Field Troop might be allotted a building or buildings in a detached position.

In such a case the unit becomes entirely responsible for its own immediate protection. It is therefore considered necessary for O.C.'s Troops to pay considerable attention to the training of their units in simple protective duties and in fire control and fire discipline. The latter training has been much neglected since the abolition of field practices in the annual musketry course of the Royal Engineers.

Digitized by Google

SCHEME "F."

(i.). Bridge Demolition.
(ii.). Defence of a Locality.
(iii.). Tactical Use of Field Troops.

NARRATIVE.

On the 5th and 6th June, fighting took place in the neighbourhood of NEWMARKET, with the result that the BLUELAND troops in that area were driven back in some confusion on THETFORD.

Considerable BLUELAND forces, however, were reported on the afternoon of the 6th to be at WISBECH and advancing on CAMBRIDGE.

The REDLAND Commander-in-Chief determined to change his line of communication to the line HERTFORD—CAMBRIDGE, and to retreat in the direction of the former place.

This movement was begun on the night of the 6th June, covered by the Cavalry Division, and was continued on the 7th June.

SPECIAL IDEA NO. 5.

At 8 a.m. on the 8th, the position of the opposing forces was as follows :—

REDLAND.—Infantry columns on the line ROYSTON—CHRISHALL—LITTLEBURY.

1st Cavalry Brigade	FOXTON.
2nd Cavalry Brigade and Headquarters Cavalry Division...	THRIPLOW.
4th Cavalry Brigade	WHITTLESFORD.
3rd Cavalry Brigade	GUNNER HALL.

The rear guards of the 1st, 2nd, and 4th Cavalry Brigades were in touch with the enemy's mounted troops on the line HASLINGFIELD—HAUXTON—SHELFORD.

At 8.30 a.m. an order, of which the following is a summary, was communicated to the C.R.E. :—

"The 1st, 2nd, and 4th Brigades with Divisional Artillery will concentrate at CHRISHALL GRANGE.

"The Engineers will, under the orders of the C.R.E. :—

"(i.). Destroy the bridges over the GRANTA from WHITTLESFORD STATION exclusive to GREAT CHESTERFORD inclusive.

"(ii.). Prevent the enemy crossing between these points.

"(iii.). Hold ICKLETON.

Digitized by Google

"The 3rd Brigade will retire slowly on LITTLE CHESTERFORD."

NOTE.—For this scheme the GRANTA is considered unfordable, except where fords are shown on the 1-in. O.S. maps.

Exercise (*K*).—At 8.30 a.m. O.C.'s Field Troops received orders from the C.R.E. of which the following is a summary :—

"Reference Divisional Orders issued this morning, the 5th Field Troop will destroy the bridges from WHITTLESFORD STATION exclusive to HINGSTON FORD ; this Troop will block HINGSTON FORD and arrange for its defence.

"The 1st Field Troop will destroy the bridges from HINGSTON FORD exclusive to ICKLETON MILL inclusive ; and the 3rd Field Troop from ICKLETON MILL exclusive to GREAT CHESTERFORD inclusive.

All *personnel* not required for the demolitions will rendezvous as early as possible at ABBEY FARM, ICKLETON, with the exception of a half-troop of the 5th Field Troop, which will defend HINGSTON FORD and send patrols as far as HILL FARM and WHITTLESFORD STATION.

COMMENTS.

(1). The orders were carried out differently by the three Troops. One O.C. divided his Troop, and sent parties independently to their two bridges and the ford previous to reconnoitring ; another took the whole Troop along his section and dropped men as required ; the third sent an officer forward to reconnoitre, and took no action until his report had been received. In the last case considerable delay was incurred, as the officer's horse got away in a ford, and it is doubtful whether, owing to this delay, the bridges in that section would have been destroyed in time. The correct procedure, it is thought, would be to send parties immediately to the sites of the demolitions, and to get tool carts with explosives to them as soon as possible. Speed in accomplishing demolition of the bridges was in this case of the greatest importance.

(2). The C.R.E. reconnoitred ICKLETON village, and divided its defence between the 3rd and 1st Troops, keeping the half-troop of the 5th Troop in reserve.

A deliberate examination of the ground at the close of the exercise raised doubts as to whether putting so great a proportion of the force at disposal into a definite defensive area was sound under the circumstances. The village was important mainly as blocking two avenues of approach, that is to say the DUXFORD—ICKLETON road and the HINGSTON—ICKLETON road. The most that a small force

Digitized by Google

could do, if attacked in such a position, would be to delay the enemy by turning him off the avenues of approach and making him go across country. It seems extremely improbable that an enemy, especially Cavalry, would butt his head against that portion of the village which lay between the two avenues of approach; it would be entirely to the advantage of the delaying force if he were to do so. The enemy's probable action in such a case would be to go round the village, and to turn the defenders out by threatening their horses which would be behind the village.

The correct solution of this problem seems to be, that one should hold the approaches only, and keep as many men as possible in reserve to delay the enemy by manœuvring on the high ground to the west, which he would probably endeavour to gain.

As every man is of value, it would appear to be uneconomical to expend men in holding the ground between the two lines of approach. The row of houses and the cross roads which join the two lines of approach, make an admirable obstacle which is hardly likely to be surmounted without considerable loss and confusion.

(3). The question of reporting progress also arose in this exercise. The Troops were allotted two separate tasks by the C.R.E., viz., firstly, to demolish certain bridges on their own account, secondly, to assemble for tactical defensive action under himself. He would have been greatly assisted in his dispositions, and relieved of considerable anxiety, if he had received information from Troop commanders as to the progress and probable duration of their demolition work and the hour at which their commands would be free for their second task, *i.e.* the defence of ICKLETON.

Digitized by Google

SCHEME "G."

Construction of a Bridge by Three Troops combined.

NOTE.—This Scheme was taken out of its proper place in the sequence of events. It should have come after Scheme "D," and have date June 4th.

NARRATIVE.

On the 3rd June, the Cavalry Division retired behind the line of the river GRANTA on to the line WHITTLESFORD-GRANTCHESTER, being followed as far as the G.E. Railway line by hostile mounted troops.

SPECIAL IDEA NO. 6.

On the evening of the 3rd June the G.O.C. Cavalry Division gave orders, of which the following is a summary, to the C.R.E. :—

"I intend to turn the enemy's right flank by a movement from MILTON across the fens on LODE and STOW-CUM-QUY tomorrow.

"With the three Field Troops you will :—

"(i.). Construct a bridge over the river CAM at MILTON, for the passage of all arms.

"(ii.). Reconnoitre the routes thence to LODE and STOW-CUM-QUY, and prepare the crossings of the fen streams where necessary."

Exercise (*L*).—Construction of a bridge by three Field Troops under the commanding officer of one.

Exercise (*M*).—Reconnaissance by officers and N.C.O.'s for routes and crossings.

Exercise (*N*).—March on routes reconnoitred.

NOTE.—The stores used for the bridge were supposed to be those found in CAMBRIDGE during the Engineer Reconnaissance of Scheme "D." Actually they were kindly lent by the Engineer Company of the Cambridge University Officers' Training Corps, and were carted to the site in Troop wagons overnight.

The spars for the trestles were unsuitably long and could not be cut.

In order to give all three Troops some work, one was given the raft, one the near trestles, and one the far trestle. The supervision of the whole was given to the officer commanding one troop.

COMMENTS.

(1). The bridge, which consisted of one barrel cut-raft, one trestle on the far bank, and two trestles on the near bank, illustrated the disadvantages of a bridge partly trestles and partly floating in a narrow river with steep banks.

Digitized by Google

(2). The plan of three Field Troops working under the orders of one Field Troop Commander on a small job proved a failure under peace conditions, owing :—

(i.). To the natural reluctance of one officer in taking complete charge of others of equal standing.

(ii.). To the comparatively large number of officers and senior N.C.O.'s who could have no definite task suitable to their rank, and therefore assumed perforce the *rôle* of spectators. This seemed to have a deleterious effect on the energy of the lower ranks.

It is suggested that, if it is necessary to carry out engineering work by more than one Troop, under the orders of an officer other than the C.R.E., either the Troops other than his own should be handed over to that officer, minus their Captain ; or only the sappers and junior N.C.O.'s actually required from other Troops should be attached for work, and higher ranks kept well in the background.

(3). Certain shortcomings in horsemastership were noticeable during this exercise. The horses were placed in a meadow where there was good grazing ; in many cases bits had not been removed and girths were found not slackened. The question as to whether saddles should or should not have been removed, on a cold, windy, rainy day is open to doubt, but the point is always worth considering when it is known that horses will be idle for some hours.

The proper disposal of the empty store-wagons was omitted, and they were left on both sides of the only approach road to the bridge.

Digitized by Google

SCHEME "H."

(i.). Bridge Demolition, Hasty Defence of Localities.
(ii.). Tactical Employment of Field Troops.

NOTE.—In this Scheme the Field Troops are supposed to form part of the BLUELAND forces operating from WISBECH (Scheme "F").

NARRATIVE.

On the morning of the 8th June the BLUE Cavalry Division of three brigades was following the retreating RED Cavalry. This was covering the retirement of its Infantry columns, which were retreating in a southerly direction.

The BLUE Cavalry advanced in three lines from CAMBRIDGE on FOXTON, THRIPLOW, and WHITTLESFORD, keeping touch with the hostile cavalry.

At 8.30 a.m. the three brigades were ordered to concentrate at THRIPLOW for action against the hostile mounted troops, which were reported to be massed near CHRISHALL GRANGE.

The Field Troops at this hour were engaged repairing the bridge at HAUXTON MILL, which had been destroyed by the RED Cavalry in their retreat.

SPECIAL IDEA NO. 7.

At 9 a.m. a Staff Officer arrived at HAUXTON MILL, and gave the following information and instructions to the C.R.E. :—

"Our left and centre brigades were surprised by the enemy's cavalry near THRIPLOW and are being pushed back in some confusion on SHEPRETH and FOXTON. Our right brigade is covering this retirement.

"The G.O.C. intends to retire across the river RHEE and rally behind the line ORWELL—HASLINGFIELD.

"The Field Troops will protect the left flank by holding HARSTON. HARSTON BRIDGE must be prepared for demolition.

"The Field Troops will retire to HASLINGFIELD when the brigades have crossed the river RHEE and hold that place."

Exercise (*O*).—Tactical and technical dispositions for hasty defence of HARSTON.

Exercise (*P*).—Preparation of bridge for demolition.

Exercise (*Q*).—Reconnaissance of HASLINGFIELD for prolonged defence.

Exercise (*R*).—Dispositions for defence of HASLINGFIELD.

Digitized by Google

On receipt of Special Idea No. 7 the C.R.E. issued orders of which the following is a summary :—

"The 1st Field Troop will occupy HARSTON village east of the HASLINGFIELD—NEWTON road exclusive.

"The 3rd Field Troop will occupy HARSTON village west of the HASLINGFIELD—NEWTON road inclusive.

"The 5th Field Troop will prepare HARSTON bridge for demolition and act as a reserve at HARSTON CHURCH. An officer will be detailed to reconnoitre HASLINGFIELD for the purpose of defence.

"The O.C. 3rd Field Troop will establish a look-out post on ROWLEYS HILL, and signalling communication thence to HARSTON."

COMMENTS.

(1). O.C.'s Troops were given 25 minutes to make their hasty dispositions and report to the C.R.E. in HARSTON.

This portion of the exercise was carried out up to time. Generally speaking the dispositions gave too extended a line. In such a case, the close defence of the bridge approaches was of the first importance. The bridge could only be approached down the main road, and the houses at the two forks were admirably adapted for the defence of this road.

After an examination of the dispositions, and when the bridge was reported ready for demolition, the Troops were retired on HASLINGFIELD, and there took up positions in accordance with the scheme prepared by the officer who had reconnoitred that place.

(2). HASLINGFIELD proved to be an exceedingly difficult locality in which to make any good prolonged defence by a very small force. Any arrangements made would have to be entirely dependent on the tactical situation. In the first place, HASLINGFIELD became untenable unless the right flank was held by supporting troops, *i.e.*, on CHAPEL HILL; this appeared to be a *sine qua non*, and if CHAPEL HILL were occupied by the enemy the Field Troops would have to abandon the village. The Field Troops themselves were certainly not strong enough to hold HASLINGFIELD for flank defence and to protect their own right on CHAPEL HILL as well. It therefore became necessary to depend on the Cavalry, whom one expected to rally north of the high ground, to hold CHAPEL HILL.

The action of the Field Troop would therefore be confined to its front and to its left flank. It seems probable that the opposing Cavalry, having found HARSTON BRIDGE destroyed, would endeavour to get round the left flank at the next crossing rather than attack frontally. The ground in the neighbourhood of FROG END therefore would be of primary tactical importance; and the

Digitized by Google

defence of the village itself of secondary importance. The correct disposition therefore seems to be to have the bulk of the Troops in reserve at the north end of HASLINGFIELD, to act where required as mounted infantry, with a half-troop picket at point 71 near FROG END, and a half-troop in the neighbourhood of MONEY HILL (south of HASLINGFIELD) to oppose any attempt at crossing near HARSTON BRIDGE.

(3). During the Training considerable thought was expended on the defence of villages. In no two cases was the solution the same ; but the following notes may perhaps be of assistance :—

(1). Villages, when first examined, are extremely puzzling, owing to the curling roads, side tracks, high walls, and the impossibility of seeing clearly. It was found, however, that a rough large-scale sketch, which can be made in three minutes from the Ordnance map, helps very much to crystallize one's ideas.

(2). Road junctions, of which there is nearly always one, are usually the important places for the purpose of close defence.

(3). If the enemy attacks across gardens and enclosures, he must lose cohesion and would certainly be delayed. Cross-country defence is therefore often unprofitable and sometimes undesirable. Communications through back gardens are, however, very useful for the defence.

(4). Very little actual engineering work is required in village defence. It is a waste of time to loophole walls which may never be manned. The value of obstacles, such as farm wagons and threshing machines stretched across the road and commanded from upper storey windows, is considerable.

(5). It is better to occupy the left side of a street parallel to the enemy's line of advance as it is easier to shoot from windows to the left than to the right.

(6). Unless flanks are guarded by troops other than the garrison of the village, a large reserve should be kept to manœuvre.

Digitized by Google

MEMORY MAP-READING EXERCISE.

(Junior Non-Commissioned Officers and Sappers).

Officers and senior N.C.O.'s, each accompanied by a proportion of junior N.C.O.'s, proceeded to the points allotted to them. The seniors, who carried maps, remained at the points, and directed the juniors to go to any other point. The juniors, who rode or bicycled, carried no maps, but had to find their way after a study of the map at each point.

Each junior carried a slip, which was filled up and initialled at the various points he visited. An example of the slip is given below.

Junior N.C.O.s were questioned at each point as to any objects of military interest, such as forage, forges, saddlers' shops, post and telegraph offices, barns suitable for billeting, water, etc., seen when coming from the last point; and were also asked to declare what topographical features they were likely to meet or see and the nature of the terrain on the way to their next point.

Point.	Description.	Officer at Point.
A.	Cross roads ½ mile N.E. of FOWLMERE	... T.S.M. "S."
B.	Heath Farm	... T.S.M. "A."
C.	Pt. 182, ½ mile S. of Heydon Grange ...	... T.S.M. "K."
D.	Summer House Farm	... Sergt. "B."
E.	Farm 1 mile due E. of Melbourn Church	... Sergt. "F."
F.	Bridge 1¼ miles due W. of Fowlmere ...	... Sergt. "R."
H.	Shepreth Church	... Capt. "K."
J.	T road ¼ mile S. of Foxton Station ...	... Lieut. "M."
K.	20th milestone on Fowlmere-Royston road	... Lieut. "N."

SPECIMEN SLIP FOR JUNIOR NON-COMMISSIONED OFFICER.

Name.....Lance-Corpl. Buggins, B.

Point.	Next Destination.	Depart.	Arrive.	Initial.
A	C	8.30	8.55	V.K. Sergt.
C	D	9.3	9.20	C.B. Sergt.
D	H	9.30	10.5	P.K. Capt., R.E.
H	B	10.10	...	—

After some little practice most N.C.O.s become very good at finding their way by memory of map. Such N.C.O.'s can be further exercised in similar work at night.

Digitized by Google

GRAVITATIONAL SHUNTING.

By LIEUT. J. W. J. RAIKES, R.E.

WITHIN the last 30 years the goods traffic conveyed on our English railway systems has increased very considerably in volume, and a large number of improvements in the system of "Transportation," to borrow an Americanism, has therefore been necessitated in order to cope with this development. A few of the most obvious are :— Increase in Engine Power. We now have engines 50 per cent. more powerful than those of a decade ago, and with this increase in engine power follows increased speed from point to point. This increased speed demands further improvements, and we find the bulk of the perishable and highly competitive traffic now conveyed in trains composed of "piped" vehicles (*i.e.* fitted with automatic vacuum or Westinghouse brakes) at little less than express passenger train speeds, rendering possible a one-day service, not only between the mills of Lancashire and Yorkshire and London, but also between London and Scotland.

Increase of train loads and increase of speed inevitably means an increase in the volume of traffic which has to be dealt with in a given time at the concentration and distributing centres, and it is one of the principal developments in the shunting yard that I propose to give a short account in this paper.

It is obvious, after a moment's thought, since the Railway Companies only charge freight on goods between two stations, such charge depending solely on the class of traffic and the distance between the stations, that all work necessitated in shunting yards, marshalling and sorting sidings and the like, is entirely unprofitable, and that every attempt should be made to reduce expenses incurred there. Consequently all Goods Traffic Superintendents will welcome any improvement tending to reduce labour and expenditure of time, provided that no increase of expense is incurred.

The efficiency of a shunting yard may be measured in minutes of engine time expended, (*a*) Standing, and (*b*) Shunting, per wagon dealt with, bearing in mind that the unit of expense is an engine in steam, and the lower this time-index the higher the efficiency and the more economical the working of the yard in consequence.

Gravitational shunting, in one form or another, is the natural outcome of these conditions, and it is with some of the main principles of this development that I propose to deal.

Digitized by Google

My remarks are based chiefly on L.N.W. Railway practice, on which railway I have had an opportunity of collecting a certain amount of information at first hand. The first application of this principle from a general railway point of view appeared some 30 years ago as the now famous Gridiron Sidings at Edge Hill, Liverpool, which example possesses the unique distinction of being not only the first but also the largest undertaking of its kind. The scheme in its origin proves again the truth of the old proverb "Necessity is the mother of invention." The L.N.W. Railway was faced with the necessity of providing additional large siding accommodation to cope with the ever-increasing traffic at Liverpool. The fact that the main lines had to be crossed in order to provide means of exchange between the different groups of sidings then in existence presented grave difficulties, especially during foggy weather, and, as the security of the passenger traffic was the first consideration, it became necessary to provide better accommodation for the goods traffic which would be independent of the passenger service.

The Railway Company possessed at that time some 60 or 70 acres of land to the north of the main lines, and it was in this direction, that the enlargement was decided upon. But to reduce this area to rail level would have meant the removal of over 2,000,000 tons of soil, an altogether prohibitive undertaking. As, however, the ground sloped gradually from east to west, a group of sidings could be laid on a uniform gradient for a comparatively small outlay. This then naturally suggested Gravitation. The idea was not wholly a new one, for, in several places for certain special classes of traffic such as coal wagons loaded or empty, gravitation was in use, but for a general goods sorting and marshalling siding the idea represented a completely new departure. The diagram shows the general plan of the sidings, and, from it, it will be seen that the arrangement consists of :—

1. Six reception lines at the top of the slope.
2. Two groups of sorting sidings, with 12 sidings in each group. In these sidings the wagons are sorted into district order. They arrive at the top of the incline "Rough" (*i.e.* in a mixed state), and as each of the sorting sidings is reserved for a particular district, the end of the first operation leaves the wagons in district order.
3. Two pairs of smaller groups of sidings, called the "Gridirons," in which the wagons are actually marshalled into station order, and from which the complete trains emerge on to the departure lines, ready for the road.

The reception lines will accommodate nearly 300 wagons; the sorting sidings about 1,100; and the "Gridirons" 72 wagons apiece;

Digitized by Google

while each of the departure lines will hold about 200, or, roughly speaking, some four trains.

Being concerned only with the principle of Gravitation and not with the siting of a shunting yard, we need say no more of the geography of the place, except that it is quite uniquely situated with respect to the different points from which traffic is received, and the various departure roads.

Every train arriving at the sidings is drawn to the summit of the incline by the train engine; enough brakes are then pinned down to ensure the safety of the train, and the engine is unhooked and goes away to fetch another trip. The whole of the sorting and marshalling process is now performed by Gravitation.

A man who has a special knowledge of the geography of the line passes quickly along the train, and chalks on the front of each wagon the number of the siding in the first groups of sorting sidings for which the wagon is destined. The couplings between the wagons are then unhooked, and the brakes of each wagon in turn, starting with the front one, are taken up. The wagons of their own accord move down the incline, the gradient of which, as will be seen from the sketch, grows steeper at the head of the sorting sidings which has the effect of separating the wagons out from one another; and thereafter, until the raft of wagons is done with, there is a continuous stream of them, separated by some 20 or 30 yards, entering the sorting sidings. Men stationed at the heads of these sidings divert each wagon in to its proper siding, in exactly the same manner as in any other shunting yard, and each man, as a wagon passes him, is responsible for pinning down a brake, or holding it down sufficiently to check its run, as it must never be allowed to get out of hand. This may necessitate a man travelling some way down the group of sidings until he has the wagon well under control. No man may pass a wagon on to his neighbour until he has checked it properly. We may say here that there is a great difference in the running powers of different classes of wagons; an empty truck fitted with grease boxes will hardly crawl along, while a heavy refrigerator van, for example, fitted with oil boxes and a somewhat ineffective brake, often requires a great deal of stopping. It is quite extraordinary to see the way in which these men, who have been properly trained to the business, deal with wagons which to the lay mind appear to have got completely out of control. A safeguard against the possibility of one getting out of hand does exist, however, and is most efficacious, when it has to be called into play. It is the "Chain drag." This appliance consists of a hook pivoted at its lower end, so that under ordinary circumstances it rests horizontally in the 4-foot, but when a wagon gets quite out of control and all ordinary means of stopping it have proved of no avail (sand thrown on to the rail will often prove most

Digitized by Google

efficacious in stopping a runaway whose brakes are properly pinned down), by the simple reversal of a lever this hook assumes a vertical position, the jaw of the hook facing the runaway vehicle and being on a level with the axle of the wagon. As the wagon passes over the hook the latter engages with the leading axle, and the wagon has now to draw the hook and the chain which is attached to it over the rough cinder ballast. The effect is to produce a very considerable drag on the vehicle, the retardation increasing as more of the chain is drawn out of the tank which contains it. The chain is heavy, weighing several tons. The runaway is thus gently but firmly brought to a standstill, without damage either to the wagon itself or to the load which it contains, and without incurring any risk to any of the men employed on the Gridiron. One may gather some idea of the weight of the chain when one realizes that it requires an engine to draw it back to the tank whence it was raised. These chain drags are only used in extreme cases and have never failed to respond when called upon. About 10 cases occur on an average every year. There are six such chain drags in use and their several positions are indicated on the plan. The chains vary from $4\frac{1}{2}$ to $5\frac{1}{2}$ tons in weight.

The profile elevation of the sidings shows the general arrangement of the gradients, varying as it will be seen from 1/60 to 1/100. The maximum gradient occurs where wagons are expected to start singly, or where they have to enter curves; on the straight where they will as a rule be moving in groups, the gradient is less. All curves are of the same radius, namely seven chains, so that a shunter may know that all curves will offer exactly the same amount of resistance to a passing wagon. No two wagons run alike, as has been pointed out above, and it requires long experience to estimate the precise amount of breaking power that is required for any particular one. The shunters employ brake-sticks to steady the speed of the wagons, and they apply these between the wheel spring and the brake lever, so as to obtain a greater leverage than would otherwise be the case if they merely pinned the brakes down by hand. Telephonic communication exists between the principal points of control of the sidings, and a very efficient system of lighting is in force at night.

In round figures the number of wagons dealt with, on an average, is 2,500 per day, while the average number of the staff employed is about 80. The cost of the shunting works out at an average of $2\frac{1}{4}$d. per wagon handled; a far lower figure than is obtained by the ordinary methods of shunting.

Another very large gravitational installation exists on the Great Central Railway at Wath, the concentration centre for the coal fields of South Yorkshire. The chief differences between this installation and that described above, are that it is designed for dealing with

Digitized by Google

coal and not with mixed goods, that all facing point connections are worked by compressed air from small ground frames, only trailing points being operated by tumblers, and that the whole of the sidings are fitted with a sort of track circuiting apparatus, which enables the man who works the points from the control cabin, or ground frame, to watch the course of each wagon on an electric indicator, and so to assure himself that the fouling point of any particular siding is clear before he turns a wagon into it. There are also other points of difference, but the gravitation principle is the same.

It must not be supposed that Gridiron methods will entirely supersede the older customs. Naturally the gravitational principle will only be economical where there is a very large volume of traffic to be dealt with, and where the local circumstances permit. Very few places are likely to possess the unique qualifications of Edge Hill, but there are nevertheless a number of other points where a minor form of gravitational shunting is in vogue. Rugby, Nuneaton, Bescot, Bushbury and Crewe are cases in point on the L.N.W. Railway. At these places the sidings or groups of sidings are as a rule more or less level, or on a slight gradient of about 1/200 to 1/300, and in order to reduce engine power expended, a modification of the Gridiron principle has been introduced.

At the head of the groups of sidings, corresponding to the summit of the incline at Edge Hill, a "Hump" or mound is formed, over which the line common to the group of sidings passes. The gradient of this "Hump" is generally about 1/40 on the side away from the sidings, and about 1/30 on the side facing them.

The length from end to end of the Hump varies, depending on the length and form of the sidings with which it is connected; the height, and therefore the length, being calculated on the understanding that the worst running vehicle, when pushed over the summit of the Hump, should run unaided to the end of the longest or most sharply curved siding into which it leads.

The principle of working is as follows. A powerful shunting engine (there is a special type for the purpose) is attached to a long raft of wagons and draws these over the Hump away from the sorting sidings, and this fact means that the neck on the reverse side of the Hump must be long enough to accommodate a long train of, say, 80 to 100 wagons. As soon as the last vehicle is clear of the summit of the Hump, the engine stops, and the wagons are chalk-marked for the different sidings in the usual manner. The shunting engine now proceeds to propel the train slowly by a series of scarcely perceptible "shoves" over the Hump, towards the sorting sidings. As the wagons mount the reverse slope of the Hump, they tend to press back on the ones which are behind them, with the result that the couplings become slack and are therefore easily unhooked. With each push from the engine a wagon, or group of wagons, is

Digitized by Google

launched over the Hump, and travels away towards the siding for which it is destined. From this point, onwards the method of working is an exact representation, on a smaller scale, of that which takes place on the "Grid."

There remains only one point with which to deal. Gravitational shunting, be it of the Gridiron or the Hump principle, reduces the engine power necessary to deal with the traffic, but owing to the greater rapidity with which the wagons follow one another and the higher speed with which they move, it is necessary to employ more shunters in proportion than is the case in other yards. Notwithstanding this fact there is a very large saving financially. But it would certainly be an advantage if some of these men could be dispensed with, and the working be rendered more automatic.

An appliance which has quite recently been invented suggests the means to obtain this end. For want of a better name we will call this appliance the "Hump Slipper."

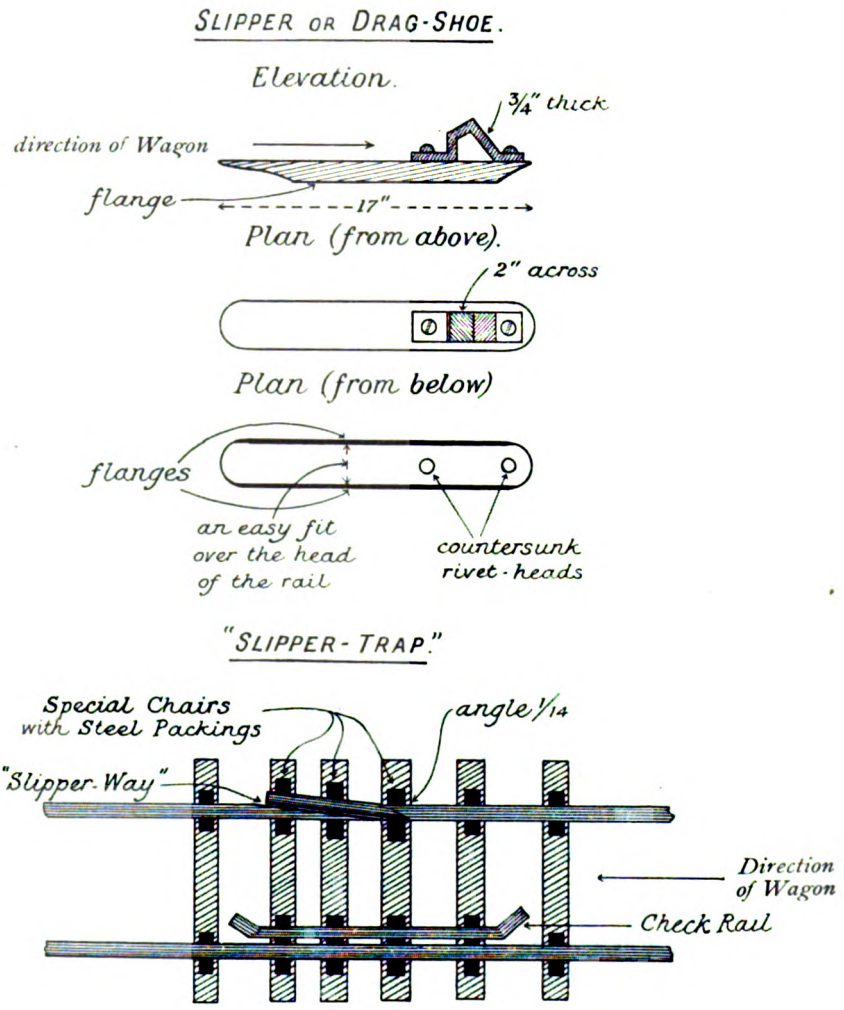
The "Slipper" is in appearance very much like an ordinary drag-shoe used on road wagons, with certain additions and this exception, that the flanges of the shoe, instead of bearing against the tyre of the vehicle, run on either side of the rail, while the wheel of the wagon rests on the upper surface of the shoe and bears against a strong stop riveted to it. A rough sketch of the slipper is given below. The sole or body of shoe is made of steel, about $\frac{1}{8}$ in. in thickness, the flanges being bent down out of it, while the stop is composed of heavier material about 2 in. wide and $\frac{3}{4}$ in. thick. This portion is firmly riveted to the sole. In the new patterns now being constructed the material is to be of steel cast in one piece, with a small removable bearing plate let into the sole, where the tyre of the vehicle being braked bears upon it and where it rubs upon the rail. The weight of the slipper is about 9 lbs.

The principle of the working is as follows. The slipper is placed on the rail in front of the oncoming vehicle at a point decided by experience, the bottom of the shoe having been freely greased. One leading wheel of the wagon as it comes down from the hump is caught by the slipper. The friction between the slipper and the rail is very considerable, sparks flying in all directions; the rotary motion of the wheel is rapidly checked and the leading axle becomes locked on the slipper, the momentum of the wagon being very soon dissipated in the heat generated between the slipper and the rail.

At a fixed point at the end of the "Braking Road" is the "Slipper Trap," a device to free the slipper from the wheel, while the wagon is not derailed but runs on quietly into the siding for which it is destined, the amount of retardation required for it to reach its proper destination having been supplied by the slipper. A sketch of the slipper trap is given below, from which it will be seen that the device

Digitized by Google

SKETCHES OF SLIPPER AND SLIPPER-TRAP.



NOTE.—*The Sleepers are closer than usual under the Trap.*

The sketches are not to scale.

is very simple. The stock rail on which the slipper is running is carried outwards from the alignment of the rail at an angle of 1/14, while the rail forming the toe of the switch in the trap is so shaped that one edge of it runs parallel to, and at a distance of about $\frac{1}{4}$ in. from, the edge of the stock rail, while its other edge continues the primary alignment of the stock rail. The small clearance between the two rails is called the "Slipper-Way," for the inner flange of the slipper enters it, the outer flange being forced to follow the outer edge of the stock rail, and the result is that the slipper gradually draws away from under the wheel, finally falling off at the end of the

Digitized by Google

trap, while the wheel, having only an inner flange which is too wide to enter the slipper way, runs on to the toe of the switch and so on to the running rail. The toe of the switch is slightly lower than the stock rail at this point; half-way between the toe and the end of the stock rail it is on a level with it; and at the end of the stock rail, the running rail is slightly the higher of the two. This difference in level has the effect of allowing the slipper to drop off more easily than would be the case if the rails were level across throughout. Special chairs, designed for the purpose, support the rails at this point, and the rail opposite to the trap is "checked."

These slippers are intended for use wherever gravitational shunting is in vogue, and the proper position for them is directly at the base of the "Hump," which will probably be made somewhat shorter and steeper in order to receive them. The braking road itself, *i.e.* that portion of the road over which the slipper will travel, should be level and from 15 to 20 yards in length; the outlet from the braking road to the sorting sidings should fall slightly towards those sidings so that the vehicles will travel without further assistance, but at the same time without undue violence to their proper positions in these sidings. The efficacy of this system of braking must be seen to be fully realized. Wagons travelling at 15 miles an hour are stopped dead within a dozen yards or less, and the risk of derailment of either empty or full wagons is so very small as to be almost negligible, and the contents of the wagons if properly secured are in no way disturbed.

It will be a long time before the adoption of the "Slipper" becomes at all general, or even popular. At present it is eyed with considerable disfavour by the older hands, but these are notoriously conservative in their ideas, and there can be little doubt that the principle has a future before it as gravitational ideas become more generally recognized.

It will certainly require great experience on the part of the men who will use it, to decide at what point the Slipper shall be placed on the road for any particular wagon so that the correct amount of braking will be applied and the wagon sent on with the proper velocity to carry it without undue violence to its ultimate destination. There are so many factors to be considered; the state of the rail, the class of wagon, the speed of the wagon, the position that the wagon has to reach, and so on which can only be solved by experience. The developments in this direction should be interesting.

Doubtless a good deal more could be written on the subject of gravitational shunting, but up to the present, at any rate as far as "Humps" are concerned, the subject is more or less in its infancy, and statistics are therefore hard to come by. This paper does not pretend to be exhaustive, but only in the nature of an outline introduction to the subject, indicating some of the possibilities of the principle and of its more recent developments.

Digitized by Google

COST OF WELL SINKING AT THE TANGRI RIVER BRIDGE, NORTH WESTERN STATE RAILWAY.

By MAJOR E. BARNARDISTON, R.E.

THE North Western State Railway crosses the Tangri River about 3 miles S.E. of Amballa, by a bridge of six deck spans of 75 ft. clear on 12-ft. cylindrical wells.

The line between Amballa and Saharanpur is being doubled, and for various reasons it was decided to build the new bridge for the second track about 250 ft. downstream of the existing bridge, and of three through spans of 150 ft. clear on piers 10 ft. wide.

A double octagonal type of well curb 24 ft. 6 in. × 14 ft. was adopted, a plan and section of which is given overleaf.

Mr. E. Fraser, Assistant Engineer, Indian State Railways, who was in charge of the work, has prepared the diagrams given on the *Plate*, showing the cost of sinking the four wells, which were completed last year, and has given me permission to send them to the *R.E. Journal*. They show the cost of labour and fuel only. The cost of erecting and removing gantries, as also workshop charges, have been divided equally amongst the four wells and shown at the top of the diagram.

Steam hoists and Bruce's dredgers were used. The latter are very good in soft material, but little use in hard ground. At the time, however, no others were available.

No. 3 Well gave a great deal of trouble. When about 40 ft. down, hard clay was met on the upstream side, and almost liquid clay on the downstream end, and it was with great difficulty the well could be kept reasonably straight.

The Tangri is a dry sandy bed most of the year, and No. 2 Well was the only one on which the work was seriously interrupted by a flood. The rates paid for labour were as follows :—

Bombay Khalassies ...	Rs.1 (1s. 4d.)	per diem.
Panjabi „ ...	As.12 (1s. 0d.)	„
Coolies	As.5 & 6 (5d. & 6d.)	„
Drivers	Rs.1 (1s. 4d.)	„
Firemen	As.8 (8d.)	„
Bihishties (Watermen) ...	As.8 (8d.)	„

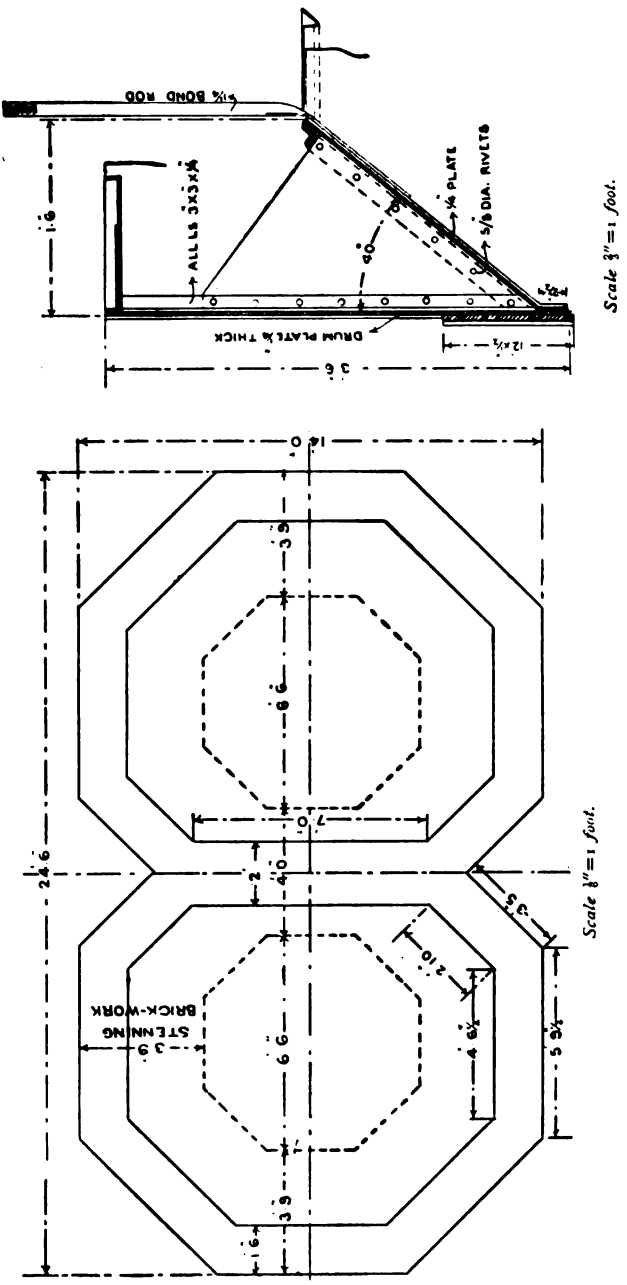
Coal cost Rs.13/14/0 (18s. 6d.) per ton delivered at the steam hoists, and each hoist required about ¾ ton per diem.

Mr. Fraser is just completing the well sinking at the Markanda River about 4 miles south-east of the Tangri, and I hope to be able

Digitized by Google

to send similar diagrams for the wells there, which are very much larger (40 ft. x 20 ft.) and the sinking of the seven wells from 40 ft. to 60 ft. deep has been completed in about three months. These diagrams should be of interest and use to officers of the Corps, who, in certain branches, may be called upon to estimate for and carry out such work at any time.

PLAN AND SECTION OF WELL CURB USED ON THE TANGRI RIVER BRIDGE.



Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(*Continued*).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

Sunday, Feb. 4th. Took up my old Qrs. in Lisbon. I find that the 79th and 94th Regts. have arrived here from England, under Genls. Picton and Hon. W. Stewart. Saw the 79th Regt. Inspected in the Rocio by Genl. Stewart.

Feb. 6th. In consequence of advices having been received from Cadiz of the French having pushed thro. the Sierra Morena, entered Seville and appeared before Cadiz, the 79th, 94th, and 87th Regts. began to embark this afternoon under command of the Hon. W. Stewart. Dined at the Artillery Mess ; but both Owen's and Hughes' Companies (just landed from England) receiving orders to embark whilst we were at dinner, every person was hurried and in a bustle this evening.

Feb. 7th. Capt. Goldfinch and myself purchased a Gold Snuff Box, for which a subscription was raised by the officers of the Corps in Portugal, and which is to be presented to the Landlord of our office in 33, Rua de Alecrim.

Feb. 9th. Lord Wellington, etc., went to Fort St. Julian ; the Col. and Capt. Goldfinch accompanied him.

Feb. 10th. The Col. set out with Lord Wellington upon his return to the army thro. Castanheira. I went to the Rua das Condes Theatre. It was on the occasion of this visit to Castanheira, that Lord Wellington—according to Sir John Jones—perceiving that it was a line open to be turned, ordered the works to be filled in. This explains the following entry in the Diary :—" Found Lt.-Col. Fletcher at Torres Vedras, and heard of the demolition of our works at Castanheira, (Feb. 13th)."

Feb. 15th. Procured Qrs. for the Col. and myself at Eiriceira where I am to remain in charge of the works in that neighbourhood.

Feb. 16. Making out my Reports upon the roads I have lately reconnoitred, and copying part of Lt.-Col. Fletcher's Report upon Peniche.

Feb. 18th. Removed my Qrs. from Mafra to this place (Eiriceira).

Rice Jones remained here, in charge of the works under construction, until May 7th. A few extracts from the Diary will suffice to give an idea of his daily duties :—*Feb.* 19. Picked out the Redoubts near the 3 Mills above Carvoeira, in readiness for the 2 Companies of the

Digitized by Google

Militia of Figueira to begin to-morrow ; tasked the men in parties of 8 each ; they work extremely hard and willingly ; reduced the parties to 5 ; the ground at the Redoubts begins to be very hard and rocky ; Mr. Miller a Conductor of Stores arrived here, to relieve a Child of the name of A. *Feb.* 28. Met Capt. Chapman ; he fixed upon the spots to destroy the roads from Picanseira to Mafra ; pointed out the lines of the Redoubts to be begun ; and the several places where the roads leading to Marvao and Ribar Mar are to be destroyed ; the principal roads are to be prepared by means of mines ; all the others are to be broken up immediately.

Accommodation had to be provided for parties of Miners from the various British Regts. employed in breaking up the roads ; and parties of Peasants had to be set to work on the Redoubts ; all of which kept our author very fully employed. Then, from time to time, difficulties arose :—" Went to the Redoubts at Picanceira, found some of the Ericeira Peasants, but could not employ them, as they had brought no tools ; the day being very wet and stormy I was obliged to order all the working parties in ; there will be no work to-morrow, being a holiday."

March 8. Col. Fletcher arrived, and proceeded to inspect the spots fixed upon for destroying the roads ; he made some alterations. An experiment is to be made upon one of the mines which is intended to complete the destruction of the roads upon the advance of the enemy. We all returned to Ericeira for dinner ; the Col. and C. slept at the Qrs. I had prepared for them at the house of the Conceilleiro. Next day, Col. Fletcher visited various points of the coast, etc., and marked out spots for Redoubts ;—" it was a very wet and windy day."

Sunday, March 11. Rode with Capt. Ross to Mafra, and then went to Cintra by the paved road ; left our horses at the English Inn and walked to the Penha Convent ; just reached the top before the sun set. Went to the Capitao Mor, and settled with him that the Company of Ordonnances of San Joao de Lampadao shall assemble at Carvoeira on Wednesday.

March 24. Major Fras. Rapozo of the Portuguese Engineers arrived at Ereceira to take over part of the works ; Rice Jones paid a visit to a Quinta at Santo Isidoro where he intended occasionally, to take up his Qrs. and ordered a bed to be prepared ; and received intelligence of the arrival of several Engineer officers from England. Such an entry as the following is of frequent occurrence—" Paid the Companies of San Joao, etc., for the past week." *Apropos*, we learn from Sir John Jones that, the difficulty of supplying so many with food was met by the Engineer officers turning Commissary, and issuing rations of bread instead of an equivalent in wages.

April 16. Began fascining the Redoubts at Picanceira. (The

Digitized by Google

Fascine manufactory was in a wood near Fonte Boa dos Nabos and the greater part of the timber required for the gun platforms, magazines, etc., in the Redoubts was supplied from the Royal Park at Mafra).

April 17. Met Col. Fletcher near Mafra, and after loading and preparing a Mine on the road below Ribar Mar; viz.—Length of Box for Powder 15 ft. 10 in., $3\frac{3}{8}$ in. square inside; Depth of mine 7 ft.; Breadth of Road from 8 to 10 ft. at top, 12 ft. below; we fired it; the effect produced was only that of the blowing away the soil with which the Mine was loaded, to a short distance, and loosening the rock to about the level of the Powder; but the cavity formed was nearly filled up by the earth which fell in upon the explosion taking place.

April 22. Our diarist rode from Ereceira to Lisbon, passing a village (name illegible) "beautifully situated on the banks of a small rivulet, to the more beautiful scenes near Bellas, and from thence by Bemfica to Lisbon. Went to my old Qrs. and found all as usual, well."

April 26. "Capt. J. T. Jones ordered to relieve me at Ereceira; I am directed to take up my abode at No. 33, Rua do Alecrim as soon as I have given up my District." (The Capt. Jones mentioned above is better known as Major-General Sir John T. Jones, Bart., R.E., the Historian of the war, and of "Journals of the Sieges in Spain.")

Setting off again, on April 30, our diarist rode with the Col. to the marshes near Alhandra; from thence, alone, to Aruda; thence to the works at Monte Agraca (where, later on, he was destined to pass many weary and anxious hours, waiting for an enemy that would not attack); thence on to Sobral, just under the Great Work, and onwards, to Enaxara. "Between Sobral and Enaxara," he writes, "near the village of Guisandeira the scenery is most romantically picturesque." With which statement I am in hearty accord; in fact, I may say, from a personal investigation of this beautiful tract of country, that a tour of the famous Lines of Torres Vedras, will prove a revelation to most people, not only in respect of the enormous strength of the position selected by Lord Wellington for stemming the flood of invasion, but for the beauty of the scenery.

May 1. "The day being very wet, Mulcaster and myself agreed to remain at home, which we did, and spent the day in reading and conversation very pleasantly." The next few days were chiefly occupied in examining and making up Pay Lists, ready for handing over charge of the District.

May 7. "Capt. J. T. Jones and myself rode along the works from Ribamar to Picanceira. Gave up everything in the district to Capt. Jones, and sent my baggage and pony to Lisbon." And on May 10. "Rode from Mafra through Bellas to Lisbon; took up my Qrs. in this city."

Digitized by Google

His friend Capt. Goldfinch had the misfortune to lose his English mare, which died of a wound in the shoulder from an Ox-goad: and poor Capt. Hamilton who had been wounded at Oporto, died on May 20, and was buried in the new Factory Burying Ground; the 2nd grave from the Hospital, on the South side of the centre walk, near a young Cyprus Tree. *May* 29. "Took charge of our Mess at this place. Completed my 22nd year; went to the Rua dos Condes (Theatre) in the evening."

June 1. "Went with Mudge on board the *Marlborough* Packet* to procure for him a passage to England in her."

The following entry of same date calls for explanation:—"Bought 11 telescopes for the Signal Stations." Rapid means of communication along the Lines of Torres Vedras being essential, signal stations, five in number were established on the most conspicuous positions; the principal one, near the centre, being on the lofty mountain of Socorro, just above the village of Pero Negro, where Lord Wellington subsequently fixed his quarters. The apparatus consisted of a mast and yard from which balls were suspended; and there being no trained signallers available amongst the troops, Lord Wellington applied for and obtained the services of a party of seamen under their own officers, from the fleet in the Tagus. And so expert did these men become after a little practice, that signals were passed from one end of the line to the other with undeviating accuracy, in seven minutes. It was for the signal-parties that the telescopes above-mentioned were purchased.†

June 4. Goldfinch and myself rode to the Rocio, where the Regts. fired 3 volleys in honour of His Majesty's Birthday, and then marched past General Leith.

June 5. Walked to the Royal Silk Factory with Mrs. Dalebarra and 2 other ladies. The Royal Silk Factory, here mentioned, had a curious history. It must be explained that, in consequence of the expulsion of the Jews from Portugal, by King Emanuel, in 1496, the decay of industry and manufactures commenced; for the Jews, here,

* The *Duke of Marlborough*, commanded by Capt. John Bull, was one of the most famous vessels of the Post Office Packet Service. While in her, that well-known officer fought more actions than any other Packet Officer. She was attacked on two occasions, while homeward bound from Lisbon, during the year 1810. (The Post Office Packet Service, by A. H. Norway).

† (The following report from Capt. J. T. Jones to Col. Fletcher is of interest:—*July* 18, 1810. I am sorry I cannot give you a favourable account of the Signal Stations; the sailors say that the distance between the stations is too great, and that the masts are all too light for the yards; on Sunday evening two were sprung; they also complain of the telescopes. I have ordered stronger masts and yards to be prepared for each post, and if better telescopes can be procured in Lisbon, I shall not hesitate to authorize the purchase of them).

Digitized by Google

as in Spain, were the commercial backbone of the kingdom; and although a few found their way back to Portugal and re-established industries, the fanatical outburst of Inquisitorial persecutions under John Vth caused a fresh exodus. Very curious too, were some of the methods resorted to by Ecclesiastics for repairing the ruin they had brought on the kingdom. Thus, a "dignified churchman," Southey tells us, founded a silk factory at Sobral, an ill-chosen situation, being a day's journey from Lisbon. But—alas! 'tis not in mortals to command success; the attempt failed, and the costly buildings were in ruins, when Southey was there.

Then the great Minister Pombal—whose hatred of the Jesuits led to their expulsion—tried his hand at the re-establishment of manufactures, and with a view to encouraging the silk industry, he imported nearly 20,000 mulberry plants from France, in 1771, and an equal number the following year, with the result that the produce of the Royal silk factory he had established at Lisbon, rose in one year, from 16,000 lbs. to 44,000 lbs. Another silk factory was established by the same Minister in an empty College of the Jesuits at Evora, "which, for want of support, soon fell to the ground," as happened to most of his manufactures," we are told by a well-informed writer.

With respect to the Royal silk factory at Lisbon, which, by the way, was protected by a severe prohibition of any importation of that article from abroad, some curious facts have come to light. Thus, even during Pombal's administration, it happened often that the looms were stopped merely through the want of money to keep them going, insomuch that the great warehouse of the factory was often without goods to meet the public demand, and the Minister was under the necessity of ordering privately, and in contravention to his own laws, silks to be smuggled from the French ships in the river, in the night-time, and afterwards sold to the public as the produce of his own manufactory.

It is interesting, in view of the above facts, to find the Lisbon silk factory bravely struggling against fate—to say nothing of the handicap of a long and exhausting war—some thirty years after the fall of the great Minister who brought it into being.

What with frequent visits to Theatre and Opera, a constant succession of friends to dinner, and dining out at other Messes, our Diarist seems to have had a gay time in Lisbon. On June 21st, several brother officers came into Lisbon to see the Procession in honour of the Festival of Corpo de Deos, which was celebrated with all its wonted splendour —the war notwithstanding :—"The Rocio was very splendidly fitted up with Tapestry and Red Velvet Hangings, and the concourse of spectators very great."

Rice Jones' pleasant sojourn at Lisbon was about to be cut short—"The Col. having received permission to join the army, which he

Digitized by Google

talks of doing shortly,"—accompanied, of course, by his Adjutant. Great events were impending on the North-Eastern frontier of Portugal, where Massena was massing his hosts for the third invasion of that unfortunate Kingdom. Ciudad Rodrigo was being besieged; General Crawfurd and the Light Division were watching events on the Coa, and Lord Wellington had established his headquarters at Celorico. Under these circumstances—and in view of the work on the Lines being well advanced—it was natural that Lt.-Col. Fletcher, as Chief Engineer, should desire to be at the front.

The Diary contains the following abstract with respect to the work on which the writer had been employed for so many months:—

July 1. Mem. of Works constructed.

	Works.	Men.
First Line.....	32	10,040
Second Line.....	65	14,600
San Julian.....	11	3,850

While, amongst his Papers are sundry Abstracts and Pay-Lists containing accounts of the daily expenditure, and number of men employed under his immediate superintendence.

It may be of interest to explain here how these defences, covering a vast extent of country, came by the designation they bear. A reference to the dates previously given will show that, except at the Monte Agraça, a point quite out of the beaten track, and almost unknown at that time to the British, the works at Torres Vedras were commenced three months before any other part of the Lines,—"which accidental circumstance," says Sir John Jones, "added to the previous celebrity of the Pass, caused their name to be given to the whole system of defence."

NOTE.—COPY.

COMDG. RL. ENGRS. ORDERS,

MAFRA, *6th July*, 1820.

As Lieut.-Colonel Fletcher, Captains Chapman, Squire, and Goldfinch are about to join the army, Capt. Jones will be left in the immediate command and superintendence of all works and other duties connected with the Engineer Department in this part of Portugal, and he is therefore to be obeyed accordingly.

(Signed) RD. FLETCHER,
Lt.-Col. Comdg. Ryl. Engineers.

Copied from the original in Lieut.-Colonel Fletcher's handwriting—Rice Jones.

Quitting Lisbon on July 5th, Colonel Fletcher and party marched *viâ* Mafra, Torres Vedras, Peniche, to Alcobaca, where the party was—"most hospitably received by the good monks of that Con-

Digitized by Google

vent; we were supplied with a plentiful dinner; and afterwards retired to good beds. Next morning, after breakfasting at the Convent, we went through the Chapel, Refectory and magnificent Kitchen belonging to it; we then set out, and after viewing the church at Batalha and taking some refreshment at the Convent arrived at Leyria; Col. Fletcher procured good Quarters at the House of Donna Maria do Candide, near the Bishop's Palace; I slept at a tolerably good yellow house at the foot of the hill."

Little did the inhabitants of these beautiful spots divine the impending storm—already gathering on the frontier,—which, in a brief while, was destined to overwhelm them; leaving nothing but ruin and desolation in its train.

Thence, the party proceeded through Pombal, Condexa—near which one of the Colonel's horses got entangled in a deep ditch, and was only extricated, with the assistance of the villagers—to Ponte de Murcella, where—writes the Diarist;—"My quarters were in a little cottage most beautifully situated above the romantic little river Alva, from the old stone bridge over which this poor village takes its name." Very full details are given of the nature of the country traversed,—size and description of the villages, and exact distance between each, with remarks on the condition of the roads, bridges, etc.; interesting only to anyone planning a tour through this part of Portugal.

The next halting place was San Jago, where quarters were only obtained through the kindness of Mr. Deputy Commissary-General Rawlings taking the party into his Quinta, where they all slept in one room. Next day, July 13th, they reached Celorico, with its narrow, dirty streets, where, again, quarters could only be got by the exertions of a friend. The town was occupied by Sir Brent Spencer and the 3rd Guards; several other Regts. being quartered in the neighbouring villages. On arrival here, they first "heard of the skirmish on the 10th and of the death of Col. Talbot of the 14th Lt. Dragoons in it; also, the account of the capture of Ciudad Rodrigo by the French was confirmed."

Meanwhile Lord Wellington had transferred his quarters to Alverca; and being unable, for lack of troops, to save Ciudad Rodrigo, had made the best preparations he could to meet the impending invasion. For Massena, at the head of an overwhelming force of veteran soldiers was about to cross the frontier; and it was clearly perceived that the only hope of saving Portugal was by assembling the numerically inferior and heterogeneous forces composing the allied army in the citadel which had been secretly constructed across the Lisbon Peninsula. It was at this crisis, says Sir John Jones, that rumours of an immediate invasion having reached Lisbon, a great impetus was imparted to the work going forward on the Lines. The

Digitized by Google

intelligence had the further effect of stirring up the Portuguese authorities, on whose assistance and goodwill the execution of the design was in some measure dependent. The conscription for labour was now extended to a distance of more than 50 miles round, and at one period, although the middle of harvest, the workers on the Lines were augmented to more than 7,000. Even women and boys took their share, being paid respectively at the rate of one-half and one-fourth the price of men ;—though to be sure, anyone who has seen Portuguese women labouring in the fields would be inclined to rate their work at a much higher figure.

July 14th. Alverca. "Here we have once more been fortunate enough to rejoin the Head Qrs. of the army ; the Col. and Chapman dined with Lord Wellington. After some trouble I got quarters in the cottage of a Cobbler on the road to Guarda."

July 15th. From Alverca the Col., Chapman and myself set out early this morning, and upon our arrival at Almeida we called upon Brig.-Genl. Cox, the Governor, by whose permission we staid to dinner, and procured Qrs. for the night. After dinner we rode to Brig.-Genl. Crawfurd's Head Quarters at the village of Valdela Mula, about 4 miles from Almeida ; found Burgoyne there and went with him to Fort Conception. By the time we had walked round the Fort, and seen the mines prepared by Burgoyne for its destruction, the lateness of the evening made our quick return to Almeida desirable, to prevent our being shut out of that Fortress. Tormented all night by innumerable hosts of Bugs at my bad billet.

Describing the country traversed this day, the Diarist thus refers to the bridge over the Coa, which was destined to play such an important part in General Crawfurd's famous fight, a week later :—"Ascended a hill and then descended to the river Coa ; a stone bridge of 3 arches, forming 3 different lines, the bank steep and very rough ; ascended a long hill to Almeida ; the country perfectly open and flat to Valda Mula."

July 16th. While the Col. and General Cox were consulting upon the defence, etc., of Almeida, Chapman and I walked round the works. Breakfasted at the Governor's and met Major Napier of the 50th Regt. ; he went with a Flag of truce to Gallegos yesterday and saw General Loison there ; he says Lord Wellington will not fight a battle to relieve Almeida. General Crawfurd retired the Infantry of his Division at daylight this morning to Guinse, (?) leaving his cavalry to cover Fort Conception. We returned to Alverca.

July 17th. Col. Fletcher and myself dined at Head Qrs. Marshal Beresford dined there also.

Sir Augustus Frazer, who commanded the Royal Horse Artillery, thus describes a dinner with Lord Wellington :—"The party consisted of 28 ; Lord W. sits in the middle of one side. Fancy smiles at the

Digitized by Google

eager looks which betray the anxiety to catch a smile from the hero of the day. A Count de Chaves and his boy were soon asleep; I and Col. Arentschild were ready to follow the example before we broke up; (at 11.30) heat, good cheer and champagne had made us all drowsy and stupid; all, however, seemed unnecessarily in fear of the great man; on his part he talked with apparent frankness."

July 21st. The French at daylight this morning drove in our outposts, and established themselves at Valda Mula. Burgoyne fired the mines at Fort Conception which answered perfectly; our videttes about 2 miles in front of Almeida this morning.

July 23rd. This evening and part of the night there was incessant and tremendous thunder and lightning with heavy rain.

July 24th. The rain continued violent the whole of this day, with thunder and lightning. Col. Fletcher and Chapman rode to Pinhel, and returned with the intelligence that the enemy, this morning, had driven the Light Division under General Crawfurd from before Almeida to the left bank of the Coa, with considerable loss. Napier, in his History, tells us that General Crawfurd "Had kept a weak division (4,000 British infantry, 1,100 cavalry and 6 guns) for three months within two hours march of 60,000 men; but this exploit did not satisfy his feverish thirst for distinction, . . . he with headstrong ambition resolved, in defiance of reason and of the reiterated orders of his general, to fight on the right bank." And the historian, who was present as a captain in the 43rd, at this memorable but disastrous fight, describes the affair with all his wonted eloquence. In the sequel, Crawfurd brought his division over the Coa, but with a loss of 272 British, including 28 officers, and 44 Portuguese, killed and wounded. The French loss was over a thousand, but,— "with a conscription, and the nations of Europe to draw on, Massena could better have afforded twenty times that number than Wellington could afford the loss of his veterans of the Light Division."

July 25. The Light Division retired before daylight and took post near the village of Carvalhal; the German Legion bivouacked near this village (Alverca). Lord Wellington and Col. Fletcher rode towards the outposts at daylight; Chapman and I followed; hearing that everything was quiet, we returned. Next day, the Light Division retired to Freixeras 3 miles from here. *July 27.* The Col., Chapman and I rode out early; at Freixeras found the Light Division, also Ross, and his brother's troop of Horse Artillery; we continued our ride to the out pickets; finding everything quiet, returned to Head Qrs. Orders given to march to-morrow. Burgoyne and Thomson sent to mine the Ponte de Murcella.

July 28. At daylight the army retired from their ground near Alverca. The Light Division came into this town (Celorico), as did

Digitized by Google

Head Qrs. We find this town nearly deserted; quartered in a white house, uninhabited and full of fleas.

Celorico, July 30. Col. Fletcher and myself rode in the evening along the banks of the Mondego, met a dragoon who informed us that Col. Wyndham, Comdg. the Ryl. Dragoons, had just been taken.

During the next few days,—"everything remained quiet, *in statu quo.*" But our Diarist had a sad misfortune—"My Batman having lost my Ass, deserted the night before last, or early yesterday morning,"—"the Col. and I took a ride with Ross, his brother, etc., to Val de Serra, a beautiful village about 2 miles south."

August 8. Went to Guarda, dined at General Coles'. The enemy have not broke ground before Almeida. Don Julian with a few of his troop pass through Guarda to Celorico. Massena said to be at Fort Conception with two Corps of his army. Deserters say they are preparing gabions, etc., for the siege of Almeida. The Portuguese peasantry on the frontier begin to show some enterprise. General Hill is still at Sarzidas; he, it is supposed intends fighting on the Abita. On the other side of the beautiful Valley of the Mondego is the romantic village of Porco, the Head Qrs. of General A. Campbell's Brigade; there are a number of large Quintas in this valley; from here the road ascends by innumerable turnings up the heights to Guarda, an ancient city, the walls of which are old and incomplete on part of one side.* The Colonel sent to Mulcaster (at Guarda) to establish a Mast and Flag for a Telegraph to communicate with one to be erected at Celorico.

Next day, the Col. went to Guarda about erecting a Telegraph there. The Staff-corps under Capt. Ross' directions continue the preparations for erecting a Telegraph at the Castle (at Celorico). Chapman received a letter from Lord Mulgrave offering him the situation of Under Secretary; it was dated 5th of May (Recd. Aug. 10) but for some unaccountable accident has been so long delayed.

Celorico, August 10. Lord Wellington publishes two letters from officers of the Army to a merchant at Oporto which had created considerable alarm in that city; His Lordship requests that officers will be more careful in their future correspondence.

This brief entry—without comment, is thus alluded by Napier:—"an officer of the Guards, writing to a friend at Oporto, indiscreetly declared that Massena was advancing in front with a hundred thousand men, and eighty thousand more were moving in rear of the allies upon Lisbon. This letter was made public, and created such a panic amongst the English merchants in Oporto that one and all applied for ships to carry their families and property away." The senior Naval

* Built in 1197 as a defence against the Moors, at an altitude of 4,500 ft.

Digitized by Google

officer on the spot applied to Lord Wellington for instructions; and his lordship, "to dry up this spring of mischief announced in general orders that he would not even seek for the authors of that and similar letters, being assured their sense and feeling would prevent a continuance of such pernicious correspondence."

The fact is that, ever since the Battle of Talavera a feeling of despondency with respect to the war in the Peninsula had been growing in England; and when, in March, Ministers of the Crown asked for a sum of money for the defence of Portugal, it was opposed by a powerful and influential party, on the grounds of the utter hopelessness—as they declared, of continuing the struggle. While in the House of Lords, Lord Grenville speaking in the same lofty strain, declared that "it was a sacred duty imposed upon them to see that not one more life was wasted, not one more drop of blood shed unprofitably, where no thinking man could say that, by any human possibility such dreadful sacrifices could be made with any prospect of success." In short, "he would consider it nothing but infatuation to think of defending Portugal with such a force."

Despondency was by no means, however, confined to a party in England: It had infected Wellington's army in the field. Even Napier admits that "many British officers laughed at the notion of remaining in Portugal; the major part supposed the campaign on the frontier to be only a decent cloak to cover the shame of an embarkation."

That these gloomy views were not shared by the army at large, however, is made clear by certain correspondence which has recently come to light:—"There is a very numerous body of officers in this army," wrote Capt. Dickson of the Artillery, (better known as Sir A. Dickson, who subsequently commanded the whole of the Artillery of the Peninsular Army under Lord Wellington), under date 27th of August, 1810, (the day of the fall of Almeida)—"who, either tired of the service, or having an idea the Portuguese won't fight, do nothing but put the worst colouring on the matter, dwelling on the impossibility of resistance against the immense force of the French, and the certainty of being obliged to embark in a short time; and all this, without the smallest knowledge of disposition or locality beyond their own division or corps." While Capt. Warre, on Lord Beresford's Staff, writing two days later, to friends at home, was even more scathing in his remarks:—"I hate grumbling and croaking, and I think it most unsoldierlike in an army such as ours, even were we less strong. We must trust to the *fortune de la Guerre*, and the abilities of our generals. I wish that every English officer thought the same, and wrote less nonsense to their friends at home."

In truth, the position of the Commander-in-Chief at this critical juncture was no bed of roses; the troubles and perplexities by which

Digitized by Google

Wellington was beset indeed would have broken the hearts of most men. For, in addition to the clamour of a formidable party at home, intent on throwing up the sponge and abasing the nation before the "man of destiny," as well as the disloyalty of certain officers in his own army, he had to face the unscrupulous hostility of the Portuguese Government, whose members, with scarce an exception, instead of exerting themselves in the national cause, not only opposed every measure necessary for the salvation of their country, but excited discontent amongst the populace. At length Wellington turned on these wretches, and with fierce rebuke warned them that "their miserable intrigues must cease, or he would advise his own Government to withdraw the British Army." But difficulties which would have driven weaker generals to the verge of despair, only steeled the nerves of this man of iron constitution and inflexible will.

(To be continued).

Digitized by Google

TRANSCRIPT.

THE SOURCE OF THE NILE.*

THE last occasion upon which the City of Dundee extended its hospitality to the members of the British Association was in 1867, forty-five years ago, and at that meeting the President of the Geographical Section was Sir Samuel Baker, who had then recently returned from his explorations on the Upper Nile, for which he had been awarded the Patron's Medal of the Royal Geographical Society, and which were of the greatest importance as regards that then little-known river.

In the Address which he gave to Section E, Sir Samuel Baker naturally referred at considerable length to the geography of the Sudan, and to the question of the sources of the Nile, which had been discovered a few years previously by Capt. Speke and Capt. Grant, when they visited the great lake, named by them the Victoria Nyanza, out of which flows the main branch of the river, the fertilizer of Egypt, which, after a course of more than 3,500 miles, pours its waters into the Mediterranean. He also spoke of the second great lake, the Albert Nyanza, which he had himself discovered, after a long and very arduous journey, though, perhaps naturally, he did not dwell so much on what he had himself accomplished, as another speaker might have done. The words he spoke are well worth calling to remembrance, and, on reading them over, one is struck by the fact that hardly anything was then known of the country through which he travelled; but that, thanks to him and his predecessors, Speke and Grant, the first steps were taken which led to half a century of steady progress in geographical knowledge, until now the basin of the Upper Nile is fairly well known and fairly well mapped.

To-day I propose to take up the tale where Sir Samuel Baker had to stop, and to give a short *résumé* of the story of the Sudan since those days, more especially from the geograpical point of view; but it will be necessary briefly to allude to its history also, for, in this case, as in all others, history and geography are closely united, and it is difficult to understand one without knowing something of the other.

There is a considerable amount of uncertainty in the minds of some people as to what the Sudan is, an uncertainty not without reason, as the word has an ethnological rather than a geographical meaning. The complete word, Balad-es-Sudan, is an Arabic expression for the country of the black people, and therefore includes, theoretically, all those parts of Africa which are inhabited by negro or negroid races. There has,

* Address delivered by Colonel Sir C. M. Watson, K.C.M.G., C.B., M.A., R.E., President of the Section, to the Geographical Section of the British Association for the Advancement of Science at the Dundee Meeting, 1912.

Digitized by Google

however, been such a mingling of different races that it would be difficult to say to what part of the great continent the word Sudan should properly be applied. But, of recent years, changing from its original ethnological meaning, it has come to be regarded as the name of a more limited area; and perhaps the simplest definition is that it includes all the country watered by the Nile and its tributaries, as far north as the twentieth degree of latitude, and excluding the Sahara, and the basins of Lake Chad and the Congo on the west, and the districts watered by the river systems which terminate in the Red Sea and Indian Ocean on the east. Such a definition does not, of course, altogether agree with the existing political divisions, as it includes the eastern part of Abyssinia, Uganda, and part of the Congo State territory; but these divisions are in no sense geographical, whereas the basin of the Nile is a well-defined region which contains the greater portion of what may be regarded as the real Sudan.

There is one point as regards the geography of the Sudan which is remarkable and perhaps unique. In former times it was to a certain extent known, and, in the maps of Ptolemy, and of the Middle Ages, the great lakes, the ranges of mountains, and the rivers flowing from them, are indicated in a distinct, if not very accurate manner. But, owing to various causes, this geographical knowledge was completely lost, and the natural features disappeared from the maps. Look, for example, at Keith Johnston's Atlas, published in 1843, and you will see that there are no lakes shown, while the Nile to the south of 10° North latitude is indicated as an insignificant stream. The Sudan had relapsed into the position of a *terra incognita*, just as it had been in the days of Herodotus, and Ptolemy and the other ancient geographers were regarded as victims of their imaginations.

The revival of the knowledge of geography of the Sudan may be said to commence with the travels of James Bruce, who visited Abyssinia in 1770, explored Lake Tsana, and found what he believed to be the true source of the Nile in the River Abai, which ran into the lake from the south. He examined the place where the Blue Nile flowed out of Lake Tsana, but was not able to follow its course through the western mountains of Abyssinia, and rejoined it at Sennaar, about 220 miles above the junction with the White Nile. Travelling along the south bank of the Blue Nile, he crossed it at the ferry of El Efun, and then went on to Halfaya, north of the site of the present town of Khartum, which at that time did not exist. Of the White Nile he says: "At half-past eight, about four miles further, we came to the village Wad Hogali. The river Abiad, which is larger than the Nile, joins it there. Still the Nile preserves the name of Bahr-el-Azrek, or the Blue River, which it got at Sennaar. The Abiad is a very deep river; it runs dead, and with little inclination; because, rising in latitudes where there are continual rains, it therefore suffers not the decrease the Nile does by the six months' dry weather." This is all he says of the White Nile, and he does not seem even to have taken the trouble to look at it, as he reports the point of junction of the two rivers as four miles north of Halfaya, whereas it is to the south of that place. He was so convinced that the Blue River was the one and only Nile that he regarded the investigation of the White Nile as

Digitized by Google

unimportant, and shows it on his map as a comparatively insignificant river. Bruce's action in this matter is a warning to explorers not to neglect to examine something that does not fit in with their preconceived ideas.

At the time of Bruce's visit the origin of the White Nile seems to have been unknown to the inhabitants of the kingdom of Sennaar, a kingdom which had been established in 1504 by the Fung dynasty, which had taken possession of what had been the Christian kingdom of Alwah. Soba, the capital of Alwah, was abandoned, and a new town built at Sennaar, which was made the seat of government. The Fungs were partly of Arab and partly of negro descent, and their kingdom extended east of the Blue Nile to the foot of the Abyssinian Mountains, and westward as far as the White Nile, beyond which were the independent kingdoms of Kordofan and Darfur. At that time there appears to have been little or no traffic on the White Nile, and the marshes of the tenth degree, inhabited by the powerful Shilluk tribes, formed an impenetrable barrier to the south.

But, although, after Bruce's expedition to Lake Tsana, the majority of people seem to have accepted the Blue River as the true Nile, there were some wider-minded persons who felt that there was a secret hidden behind the marsh barrier. One of these was a certain Mr. W. G. Browne, who made an interesting journey to Darfur in 1793, and who records in the account of his travels that he had the conviction that the river, of which Bruce had discovered the source, was not the true Nile, and that he considered it a matter of great importance that the course of the more western river, *i.e.* the White Nile, should be investigated, as he could not believe that its source was only two hundred leagues south of Sennaar.

Starting from Egypt, Browne travelled with a merchant's caravan from Assiut, by way of the oases of Khargeh and Selima, to El Fasher, in Darfur. Here he remained for three years, but was not able to do much in the way of exploration, as he was thwarted by the king and people, and was not allowed to go to Sennaar or to explore the White Nile. He collected, however, from the accounts given him by the natives, a good set of itineraries in Darfur and Kordofan, the first, so far as I know, compiled for the Sudan. But his efforts to obtain information as to the source of the White Nile were not successful, and all he was able to learn was that ten days' journey south of a place called Abu Telfan, the Bahr-el-Abiad had its source in forty rivers, which came from the hills of Kumr. It seems probable that these numerous rivers were those that form the head waters of the Bahr-el-Ghazal, and that the people of Darfur knew as little about the Bahr-el-Gebel, as the southern part of the White Nile is called, as the people of Sennaar.

But although Browne was not able himself to solve the mystery, his name should not be forgotten, as being one of the first in modern times to realize the fact that the White Nile was the longer of the two rivers. His views, however, seem to have met with no support, and Bruce was supposed to have settled the question of the sources of the Nile. The great lakes, shown by Ptolemy and the mediæval geographers, were, as I have already mentioned, erased from the map, and the White Nile was left in peace.

Digitized by Google

During the visit of Browne to Darfur the kingdom of Sennaar had fallen upon evil times, as an insurrection, which had commenced during the reign of Bady, ended with the death of King Adlan in 1789, when the Fung dynasty came to an end, and all authority fell into the hands of the tribal chiefs, who made and removed the kings of Sennaar at their pleasure. The internecine wars continued up to the time of the arrival of the Egyptians in the Sudan, and greatly facilitated the advance of the latter.

This advance of the Egyptians was due to the policy of Mahomed Ali Pasha, the Turkish Governor of Egypt, who had greatly increased his power by a successful campaign in Arabia in 1812–18, when he succeeded in capturing Mecca and Medina, and made himself master of the country. He then turned his attention to the Sudan, and decided to take advantage of the local troubles and to add Sennaar and Kordofan to the Egyptian dominions. In 1820 he sent an army up the Nile, under his son Ismail, who took possession of Dongola and the country adjacent to the river, as far as the junction of the Blue and White Niles, and, after seizing Sennaar, marched up the Blue Nile to Fazokl, on the Abyssinian frontier. Kordofan was also occupied, and the capital of the new Egyptian province was placed at Khartum, the point where the two Niles met, which took the place of the old capital of Sennaar; but no attempt was made to take possession of the country along the White Nile to more than about one hundred miles south of Khartum. So little was that river known beyond this, that, when Linant Pasha succeeded in sailing up the river as far as the Island of Aba, he was supposed to have arrived at the furthest point reached by a European since the first century.

No further advance was made for a few years, but, in 1838, Mahomed Ali decided to try to open up the White Nile, and an expedition under Major Selim, of the Egyptian Army, succeeded in making its way through the marsh district, and in reaching a point about 6° 30′ North latitude on the Bahr-el-Gebel, while another expedition in 1842 got as far as Gondokoro. It was thus proved that the marshes were not impenetrable, and trading stations began to be opened up, both on the Behr-el-Gebel and the Bahr-el-Ghazal. On the former river, however, the traders could not at first proceed further than Gondokoro, as the rapids, which commenced a few miles south of that place, made navigation by sailing vessels impracticable, so the merchants had to establish their depôts at Gondokoro and depend upon the natives bringing ivory from the south. To these natives the opening of the river proved a great evil, as the legitimate traders were soon followed by slave-hunters, who carried thousands into captivity, while killing many others. By the ill-will thus created the difficulty of exploration was increased. In the end, the source of the White Nile was discovered not from the north, but from the south, when Capt. Speke, who, in company with Capt. Burton, was exploring Central Africa from the east coast, heard of a great lake lying to the north, and succeeded in reaching the south end of the Victoria Nyanza in 1858. Convinced that he had found the long-desired source of the Nile, he started on another expedition, accompanied by Capt. Grant, in 1860, and, after marching round the Victoria Lake, reached Gondokoro in 1863. Here he met Sir Samuel Baker, who had started from Khartum

Digitized by Google

in 1862, in the hope of discovering the Nile sources. The information given by Speke and Grant showed that they had forestalled him; but he continued his journey, and in 1864 succeeded in reaching the Albert Nyanza, the second great lake from which the White Nile derives its water.

Thus, at length, after a lapse of many centuries, the truth of the statements made by Ptolemy and other ancient geographers was justified, and the lakes shown by them were restored to the map of Africa, while the White Nile was proved to be the real Nile, and the Blue Nile was relegated to the position of being the most important tributary.

During the period of the travels of Speke and Baker the slave trade had been rapidly increasing, and the traders had practically taken possession of the country, and made themselves independent of the Egyptian authorities in Khartum. These slave traders cared nothing for geography, and had matters remained as they were at that time, it is probable that a State hostile to Europeans would have been established, and all chance of further exploration would have been lost.

But in 1869 the Khedive Ismail, who had succeeded as ruler of Egypt in 1863, and had obtained largely increased powers from the Sultan, decided to restore his authority on the White Nile, and appointed Sir Samuel Baker as Governor of the country south of Gondokoro, with instructions to establish Egyptian rule as far as he could, to the south of that point. But nature fought against Baker, and the difficulty of sailing up the White Nile had been enormously increased by the formation of the sudd, that strange vegetable barrier which at times completely closes the river channel; and he did not reach Gondokoro until two years had elapsed from the time of his departure from Khartum. There he hoisted the Egyptian flag, and then proceeded to occupy the country to the south. But he was not successful, as the force at his disposal was quite insufficient, and, though he established a few stations on the road from Gondokoro to Foweira, on the Upper Nile, little effective had been done when he returned to Gondokoro in April, 1873. Neither was he able to do much in the way of geographical research, and, greatly to his regret, was unable to revisit the lake which he had discovered on his first journey.

In 1874 Colonel Gordon was appointed to succeed Baker, and, leaving Khartum in March, reached Gondokoro in twenty-four days, the sudd, fortunately for him, having been cut through by the Egyptian officials only a month before his arrival in the Sudan. Gordon ruled the equatorial provinces until October, 1876, and during that time did much to tranquillize the country, as he had a remarkable influence over the natives. He moved the headquarters of the government from Gondokoro to Lado, and established a chain of posts along the Nile to Duflé, and thence to Nyamyongo, in Uganda, about eighty miles below the Ripon Falls. He also placed two steamers and two sailing-boats on the Albert Lake to facilitate communication. Gordon devoted much attention to the geography of the district, and prepared a map of the White Nile from Khartum to Urondogani, superior to any that had preceded it. This map included a plan of the Albert Nyanza, based on surveys made by Gessi and Mason, both of whom circumnavigated the lake. Mason reported the existence of the river, now called the Semliki, entering the

Digitized by Google

lake from the south, but was unable to enter it, as the water was too shallow for his vessel.

Soon after his arrival at Gondokoro Gordon fully realized the difficulty of keeping up communication with Egypt by the Nile, and requested the Khedive to send an expedition to Formosa Bay, about a hundred miles north of Mombasa, on the east coast of Africa, with a view of opening up a road towards the Nile. The route he thought of was a little north of that now followed by the Uganda railway; but at the time he made the proposal the country was entirely unknown, and the difficulties would have been much greater than he anticipated. The idea, however, came to nothing, first, because the expedition was sent to the River Juba, on the border of Somaliland, which was much too far to the north, and, secondly, because it was ordered away by the British Government, which considered that it was encroaching on the territories of the Sultan of Zanzibar.

At the time that Gordon was establishing Egyptian authority in the equatorial provinces the Khedive's dominions were being extended by the conquest of Darfur, and the occupation of the province of Harrar, with a port at Zeila, in the Gulf of Aden. An excellent reconnaissance of Kordofan was carried out by Colonel Prout, of the United States Survey Department, in 1875, and a reconnaissance of Darfur was made by Colonel Purdy, another American in the Egyptian service, so that considerable additions were made at this period to the geographical knowledge of the Sudan.

But soon afterwards there was a serious setback to the Khedive Ismail's projects of conquest. Having acquired Massowah, Tajurra, and Zeila, on the Red Sea, he sent an expedition into Abyssinia in 1875, which was cut to pieces at Gundet, on the road to Adua, and another larger force sent in the following year was utterly defeated by the Abyssinians and had to retreat, with great loss, to Massowah. Some surveys were made by the American officers on the staff of the Egyptian Army, but these expeditions did but little for geography, and their fate was the precursor of the destruction of Egyptian power in the Sudan.

Colonel Gordon returned to Egypt in December, 1876, and early in the following year was appointed Gevernor-General of the whole Sudan, a post he held for nearly three years, years of incessant labour, during which, much to his regret, he was able to do little for geography; as, though he travelled many thousands of miles through his vast territories, his whole time was occupied with questions of administration. He was wonderfully successful in his dealings with the inhabitants, and had he been left alone for a few years, the history of the Sudan would have been different; but he was constantly urged to send money to Cairo, money which he could not obtain without following the example of his predecessors and oppressing the inhabitants. This he would not do, and resigned in August, 1879, when he was succeeded by an Egyptian Pasha, who revived the old bad customs of the country. His appointment led to the result that might have been anticipated, and, in 1881, the revolt led by Mahomed Achmed, the Mahdi, broke out, and the Egyptians were driven out of the Sudan. Then the country was completely closed to Europeans, and nothing further could be done in the way of geographical discovery

Digitized by Google

until the defeat of the rebels at Omdurman in 1898. Now, fortunately, peace is restored, a peace which, it may be hoped, will be a lasting one.

To geographers, of course, the existing state of affairs is very satisfactory, as it will undoubtedly lead to an increase in our knowledge of the Sudan and its resources. That knowledge is still very limited, much more so than many people are aware, and there are vast regions which still stand in need of careful examination. Maps, especially small scale maps, are misleading, and convey the impression that more is known than is really known. Take, for example, the case of the Blue Nile, one of the most important tributaries of the great river. Of this, the head waters, Lake Tsana, first carefully examined by James Bruce, are fairly well known, and a good reconnaissance of this lake was made by Mr. C. Dupuis, of the Egyptian Irrigation Department, in 1903, a copy of whose interesting report is attached to the valuable report on the basin of the Nile, made by Sir W. Garstin in 1904.

The course of the Blue Nile from Famaka on the Abyssinian frontier to Khartum is fairly well known, although not yet accurately surveyed. But of the river between Lake Tsana and Famaka, and of its course through the mountains of Abyssinia, our knowledge is most elementary, and it is doubtful whether the line as marked upon maps is correct. Here is a chance for a resolute explorer to distinguish himself by making a really good reconnaissance of this part of the river, and following it carefully from Lake Tsana to Famaka. But it would probably be rather an arduous task, and there would be many difficulties, natural and human, to overcome.

The question of the Blue Nile is only one of the many geographical problems to be solved in the Sudan. The upper waters of other tributaries, such as the Atbara, the Rahad, the Dinder, and the Sobat, and the mountains from which they flow, are also little known, and will require years of exploration, while great areas of the level country of the Nile basin remain unvisited and unsurveyed. This can be well realized by anyone reading Sir W. Garstin's excellent report already mentioned, in which he gives an admirable summary of the hydrography, and deals with the important question as to the manner in which the water of the different tributaries of the Nile can best be utilized for improving the agricultural capacity both of the Sudan and of Egypt. Among other projects with this object he proposes the cutting of an entirely new channel of more than two hundred miles in length, so as to allow the waters of the Bahr-el-Gebel to leave the existing channel at Bor, eighty miles north of Gondokoro, and to rejoin the Nile near the mouth of the Sobat below the sudd district; but, as he justly points out, the country through which this new channel would pass is practically unknown, as the whole of the area lying between the Bahr-el-Gebel, the Bahr-ez-Zaraf, and the Sobat is a *terra incognita*.

Sir W. Garstin points out that there is a great loss of water from the Bahr-el-Gebel between Gondokoro and Bor, for which he cannot account, and this is another point requiring to be investigated. Reading his remarks upon this subject reminds me of the time when I was assisting in General Gordon's survey of the Nile, when, on this part of the river, at

Digitized by Google

a point about fifty miles north of Gondokoro, I noticed a considerable branch leaving the Bahr-el-Gebel, and going apparently in a north-easterly direction. The native pilot told me that it was reported by the inhabitants to join the Sobat. It was impossible to investigate the truth of this statement, which, at the time, seemed rather doubtful, but it is interesting to note that a high authority like Sir W. Garstin records that the Nile loses a considerable volume of water near this place.

Whether the proposal of Sir W. Garstin to make this great canal will ever be carried out is doubtful; for my own part, I am inclined to think that, having regard to the amount of work to be done in the Sudan, it would be better to leave the Bahr-el-Gebel alone for the present. The cost of a canal such as that suggested would be very large, and if funds were available it would be better to spend them on a railway from the Sobat southwards. Sooner or later the railway, which now runs some distance south of Khartum to the point where it crosses the White Nile into Kordofan, will be extended, and in process of time will reach the Sobat. Meanwhile it might be worth while to select a point on the Sobat suitable for a bridge, and to make that point the northern terminus of a line of railway, leading southwards to Gondokoro, and later, on to Uganda. Communication between Khartum and this terminus would, for the present, be kept up by the White Nile, which, with the exception of one or two places, is navigable for the whole year.

Looking at the question of the Sudan from the geographical point of view, there has been a wonderful increase of knowledge since the last meeting of the British Association in Dundee; but, on the other hand, there is a larger amount of work yet to be done before the whole of the vast area will have been satisfactorily surveyed, and it must be remembered that the Sudan Government has claims of greater importance at present than that of carrying out a complete trigonometrical survey. But exploration will no doubt be carried on year by year, and the blank spaces on the map will gradually be filled up. Meanwhile we must wish Godspeed to the British officers in the Sudan, who are carrying out a great work of civilization, and, at the same time, adding to the geographical knowledge of the world.

Leaving the Sudan, I would like to allude to a very important geographical undertaking which has made considerable progress during the past year. This is the production of the International Map of the world on the scale of $\frac{1}{1000000}$, a project which has been under the consideration of the leading geographers of the important countries for more than twenty years, since it was first proposed at the International Geographical Congress held at Berne in 1891. The question was discussed at succeeding Geographical Congresses, but did not take definite shape until the meeting held at Geneva in 1908, when a series of resolutions dealing with the subject were drawn up by a Committee composed of distinguished men of many nations, which was appointed to formulate rules for the production of the maps, so as to ensure that they should be prepared upon a uniform system.

These resolutions were approved at a general meeting of the Geneva Congress, and were forwarded by the Swiss Government to the British

Digitized by Google

Government for consideration, whereupon the latter issued invitations to the Governments of Austria-Hungary, France, Germany, Japan, Russia, Italy, Spain, and the United States of North America, asking them to nominate delegates to act as the members of an International Committee to meet in London and debate the question. This Committee assembled at the Foreign Office in November, 1909, and Colonel S. C. N. Grant, C.M.G., then Director-General of the British Ordnance Survey, was appointed President. The proceedings were opened by the Under-Secretary of State for Foreign Affairs, Sir Charles Hardinge, G.C.M.G., now Lord Hardinge, who, in his address, referred to the progress that had already been made with regard to the International Map, and expressed the hope, on behalf of the British Government, that the great undertaking might be brought to a satisfactory conclusion.

The main business before the Committee was to settle on the mode of execution of the map, especially as regards the size of the sheets, so as to ensure that adjacent sheets, published by different countries, should fit together; and also to settle upon the symbols, printing, and conventional signs to be used, in order that these should be uniform throughout. A series of resolutions, embodying the decisions arrived at concerning these various points, was approved and drawn up in English, French, and German, the first of these languages being taken as the authoritative text. As the map was to embrace the whole surface of the globe, the method of projection to be adopted was, of course, a very important consideration, and, after due deliberation, it was decided that a modified polyconic projection, with the meridians shown as straight lines, and with each sheet plotted independently on its central meridian, would prove the most satisfactory.

The surface of the sphere was divided into zones, each containing four degrees of latitude, commencing at the equator, and extending to 88° North, and 88° South latitude. There were thus twenty-two zones on each side of the equator, and these were distinguished by the letters A to V north, and A to V south. This fixed the height of each sheet. For the width of the sheets, the surface of the sphere was divided into sixty segments, each containing six degrees of longitude, and numbered consecutively from one to sixty, commencing at longitude 180°. This arrangement made each sheet contain six degrees of longitude by four degrees of latitude; but, as the width of the sheets diminished as they approached the poles, it was decided that, beyond 60° North, or 60° South, two or more sheets could be combined. Each sheet could thus be given a clear identification number defining its position on the surface of the globe, without it being necessary to mention the country included in it, or the latitude and longitude. For example, the sheet containing the central part of England is called North, N. 30.

In order to ensure that the execution of all the maps should be identical, a scheme of lettering and of conventional topographical signs was drawn up and attached to the resolutions; and it was decided that a scale of kilometres should be shown on each sheet, and also a scale of the national measure of length of the country concerned. As regards the representations of altitude it was arranged that contours should be shown at vertical intervals of a hundred metres, or at smaller intervals in the case

Digitized by Google

of very flat, and larger in the case of steep ground, the height being measured from mean sea level, as determined in the case of each country; while the levels of the surface of the country were to be indicated by a scale of colour tints, the colours being green from 0 to 300 metres, brown from 300 to 2,500 metres, and purple above 2,500 metres. In the same manner the depths of the ocean and of large lakes were to be indicated by varying tints of blue, so as to show intervals of 100 metres. In order to ensure uniformity in the scale of colours to be used, a copy of it, as approved by the Committee, was included in the plate of topographical symbols.

The whole scheme was thoroughly well worked out, and great credit is due to the members of the International Committee for the manner in which they carried out their difficult task. Since the meeting of the Committee in 1909 the preparation of the sheets, in accordance with the principles decided upon, has been taken in hand in several countries, and a number of these have been issued, which give a good idea of what this great map, the largest ever contemplated, will be like. These sheets deserve to be carefully studied, and will doubtless be the subject of considerable criticism, as there are several points which seem worthy of examination.

In the first place, it is for consideration whether it would not have been better if the colour scheme for representing differences of altitude had been omitted, as it is doubtful whether the advantage of the result gained is commensurate with the increased cost of printing the colours. And one naturally asks for what purpose is the map intended. Is it for the use of skilled geographers, of whom there are a comparatively small number in each country, or is it for the instruction of ordinary people? If it is for the latter, it is to be feared that the colour scheme will give rise to erroneous impressions. Compare, for example, Sheet North, M 31, of France, with Sheet South, H 34, of part of South Africa. In the former, as the greater part of the country shown is less than 300 metres above the sea, the general colour of the sheet is green, while in the latter, as nearly the whole of the country included has an altitude of more than 300 metres, the map is for the most part brown. This to the less educated man will probably convey the idea that, while France is a fertile country, South Africa is a desert. The fact, too, that the darker tint of green represents the lower level and the lighter the higher, while, in the case of the brown, the lighter represents the lower and the darker the higher, and, in the case of the purple, the relative strength of the tints is again reversed, is rather confusing.

There is another point as regards the colour scheme which might be noticed, that is, that it is not the same on different sheets. For example, the scale of tints adopted in Sheet North, O 30 (Scotland), North, M 31 (France), and North, K 35 (Turkey), do not correspond. In the Scotch map the brown colour commences at an altitude of 200 metres, in the French at 300 metres, and in the Turkish at 400 metres. There may be some reason for this, but it appears not to be in accord with the resolutions of the Committee. Another reason for omitting the colour scheme for altitudes is that it might be better to keep colour work for other purposes, such as indicating political divisions, as there can be little doubt that so good a map as this, when completed, will be largely used

Digitized by Google

for many purposes. It might be better that on a map of this small scale only the horizontal features, such as coast lines, river courses, railways, roads, and the position of towns should be shown, while to represent height graphically tends to obscure the former.

Another criticism I would venture to make is that the resolutions of the Committee appear to have been drawn up on the supposition that the whole world has been accurately surveyed, and no attempt seems to have been made to distinguish between those regions of which the maps are based on triangulation, such as England and parts of Europe, and the countries of which complete surveys have not yet been made. As the construction of the map proceeds and sheets are prepared of parts of the world our knowledge of which is imperfect, this want will become more pressing, but it is noticeable even with regard to the sheets already published. It is one of the evils of cartography that where anything is shown on a carefully engraved map it comes to be regarded as true, and, if it afterwards turns out to be erroneous, it is not easy to get it altered.

The scale of the map, $\frac{1}{1000000}$, appears to have been wisely chosen, as it is sufficiently large to give an adequate amount of detail, while, at the same time, the sheets will not be unduly numerous. Of course, for an International Map a natural scale was essential, although for national maps a scale based upon the national system of measures is more convenient, as, for example, in the United Kingdom, where the scales of one inch and six inches to the mile are better than scales of $\frac{1}{500000}$ and $\frac{1}{10000}$ would have been. They are more suited for the majority of individuals, and an ordinary foot-rule can be used for measuring distances, instead of having to take them off with a pair of dividers from the printed scale on the map.

Looked at from the general point of view, there can be no doubt that the International Map is a most important and valuable undertaking. It is satisfactory that such a leading part in the matter has been taken by the British officers of the Royal Engineers and by the Royal Geographical Society.

In speaking of this map I have referred to the advisability, if not the necessity, of distinguishing between what is accurately and what is inaccurately known, and this brings me to another matter of considerable interest, the preparation of maps based upon the observations and information collected by explorers in unknown or little-known countries. To these explorers, some of whom have not been trained in geographical science, a large amount of detail shown upon modern maps is due, and it is only a small proportion of the land surface of the globe that has, up to the present, been surveyed in a scientific manner.

It is therefore of the greatest importance that the best value possible should be obtained from the work done by explorers, and this in the past has not always been sufficiently attended to, though during the last few years it is better understood. The people who stop at home in comfortable ease do not sufficiently realize the difficulties under which the conscientious traveller works and gathers together information about the country he passes through. Formerly, he generally had to work out his own observations and compile his own maps, but now conditions in this respect have greatly improved, and when he brings home his observations, notes, and sketches he can hand them over to some body, such as the Royal

Digitized by Google

Geographical Society, by whom they will be put in shape in a better manner than he could do it for himself. One has heard of an explorer in a little-known country sitting up all night after a hard day's work, working out his astronomical observations, and trying to put his rough surveys into shape. He would have done better to have gone to sleep and prepared himself by a good rest for the next day's journey. In fact, it would be better if an explorer never looked at the figures of an observation after he had recorded them, or read over the notes of his past work, confining himself to recording what he has actually seen day by day as accurately as circumstances permitted, and carefully distinguishing what he really saw from what he thought he had seen, or what he had heard.

It would be easy to adduce instances of the errors which have arisen from the neglect of such precautions. Perhaps one of the best known is that I have already alluded to, when James Bruce, a careful explorer, because he had made up his mind that the Blue Nile was the real Nile, passed the White Nile without taking the trouble to examine it, and recorded it as being a comparatively insignificant river. Then, there was the case of Sir Samuel Baker, who having reached the shores of the Albert Nyanza with great difficulty, relied too much on what he was told by the natives, and showed it on his map as extending many miles to the south of the equator. But great responsibility rests also upon those who have the task of compiling a map from the notes of an explorer, and the greatest care has to be taken to show only what is really known, and not what is uncertain. Geographers, whether in the field or in the drawing office, should always hold up before themselves a standard of accuracy higher than it is always easy to live up to.

Geography under its more ancient name of geometry is, of course, the mother of all sciences, although at the present time geometry has got a more narrow meaning, and is perhaps regarded by some as independent of geography, although really only a branch of it. The study of the earth upon which they lived was to the ancient nations the most important of all studies, and it is interesting to trace how astronomy, mathematics, geology, and ethnology are all so interspersed with geography that it is difficult to separate them. It is satisfactory to note how from the very first the British Association has always recognized the great importance of geography, since the first meeting of the Association at Oxford in 1832, when Sir Roderick Murchison, so well known to fame, acted as President of the Geographical and Geological Section. These two sciences remained united in the same section until the meeting at Edinburgh in 1850, when Sir R. Murchison was again the President. But, at the next meeting at Ipswich in 1851, they were separated, and while Geology remained as the subject of Section C, Geography, on account of its great importance, was made the subject of Section E, and the science of ethnology was united with it. Sir R. Murchison was the first President of the new Geographical Section, and was afterwards President no fewer than six times of Section E, showing the great importance attached by him to the study of the science of Geography. May I express the hope that the Presidents of the Section will endeavour in future to follow, however humbly, in the footsteps of that leader of science.

Digitized by Google

CORRESPONDENCE.

ROLL OF THE CORPS.

DEAR SIR,

In the *R.E. Journal* for July, 1911, there appeared a short notice of the Indian services of T. H. Elliot and F. E. Elliot, Nos. 437 and 523 respectively on the *Roll of the Corps.*

These two officers were brothers, and the sons of Mr. Hugh Elliot, Governor of Madras 1815–20, on whose staff they served. There appears to be little doubt that T. H. Elliot was present at the Battle of Seetabuldee, for in "The Life and Correspondence of Sir J. Malcolm" there occurs the following sentence which refers to Sir John's journey to join his division at the commencement of the second Mahratta War, 1817:—

"He (Sir John Malcolm) had moreover, at this time, some guests in his camp . . . Captain Henry Elliot, son of the Madras Governor; Dr. Gordon of the Nagpoor Residency. . . . On the 20th September (1817) Malcolm and his companions entered the province of Berar, and on the 24th he arrived at Nagpoor. . . . On the 4th October Malcolm prepared to depart from Nagpoor."

This fits in exactly with Sir J. B. Hearsey's statement (printed in the July, 1911, number of the *R.E. Journal*) that the Captain Elliot present at Seetabuldee had been left at Nagpoor sick when Sir John passed the Residency there on his way to Indore; and accounts for the mistaken impression left on Sir J. B. Hearsey's mind that Elliot was Sir John's aide-de-camp.

It is an interesting fact that the Corps was represented on such a celebrated occasion, and is an apt illustration of the Corps motto.

Yours faithfully,

H. BIDDULPH,

Major, R.E.

October, 1912.

The Editor, *R.E. Journal.*

Digitized by Google

RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEWS OF BOOKS.

[Reprinted from *The Army Review* by permission of the Controller of His Majesty's Stationery Office.]

o o o o o

HISTORY.

HISTORY OF THE RUSSO-JAPANESE WAR. Compiled by the Japanese General Staff (Nichi-Ro Senshi, Sambo Hombu Hensan). Vol. I. 746 pp. 27 Appendices, and case of maps. 8vo. Tokyo, Kaikosha, June, 1912. Complete in 10 vols., £5 16s. 5d.

Although the first volume of the Japanese official account appears eight years after the events which it describes, the summary of contents shows that the work of compilation has been a considerable one. The 10 volumes contain over 10,000 pages, while there are over 800 maps outside the text.*

The difficulty that the military student must experience in extracting lessons from so large a mass of material is increased by the absence of an index (the Japanese language not lending itself to this convenience) and of comments.

It is evident that an official history compiled by officers who are still the subordinates of the men who took a leading part in the war cannot contain candid criticisms, and it is equally comprehensible that no nation willingly makes a gift to its rivals of the practical lessons that it has purchased so dearly. At the same time so entire an absence of self-revelation is a matter for regret. At no time, at any rate in the first volume, is the reader allowed to see into the minds of these great soldiers; and a history which merely chronicles events as they occur and orders after they are issued, is but a skeleton.

GENERAL ARRANGEMENT.

The history deals with the operations on land, the naval account being a separate publication.

The chief events treated in the different volumes are as follows :—

Vol. 1.—Causes of the war. The rival armies. Japanese and Russian plans of campaign. Epitome of the naval operations. The Yalu, Nanshan, Te-li-ssu. Landing of the 10th Division.

Vols. 2—4.—Ta-shih-chiao. Liao-yang. Shaho.

Vols. 5—6.—Siege of Port Arthur.

Vol. 7.—Events after the Battle of Shaho.

Vols. 8—9.—Mukden.

Vol. 10.—Occupation of Saghalien. Lines of communication and services in rear of the army.

Each of the 16 sections into which the whole history is divided is preceded by a summary of the events dealt with in the section in question. At the end of each chapter is an account of the Russian movements which took place during the period under notice. By the use of different type the information of the enemy that was known to the Japanese at the time is distinguished from the facts revealed by subsequent investigation.

* Succeeding volumes are advertised to appear at 1—3 monthly intervals, and the final volume in October, 1913.

Digitized by Google

The maps show the positions of units with great clearness and detail, a result which is mainly due to the Japanese system of conventional signs for troops which is very complete. The nomenclature of Japanese units which are known by numbers only is also less cumbrous than our own.

Orders of battle, lists of casualties (including losses in horseflesh), and ammunition expenditure during the principal engagements and copies of orders are given in the appendix.

Causes of the War.

The opening chapter on the "Causes of the War" is very brief (14 pages). Remembering that a chief one was Japan's determination to show the world that she would no longer continue to be treated as a negligible quantity, there is a dignified restraint in the account of her relations with Russia before the war. The retrocession of Port Arthur in 1895 may be quoted as an illustration of this absence of recrimination over past injuries. The account of the incident occupies two lines in the original, and is as follows: "As one result of the 1894–5 campaign China ceded to Japan the Liao-tung Peninsula; but, on the ground that the peace of the Far East was affected thereby, Russia, together with France and Germany, demanded that Japan should relinquish it. Our Government had no other course but to accede to this demand."

A glimpse of the Japanese attitude, however, appears in the reference to the Russian naval manœuvres in the Yellow Sea and the artillery practice from Vladivostock in May, 1903, "which tried to intimidate us with the noise of their fire."

It is interesting to know what information was in the possession of the Japanese Headquarters at the beginning of February—*i.e.*, on the eve of war—since it affords a clue to the reasons why the Japanese broke off the negotiations when they did. The history summarizes this information as follows:—

"About two battalions of infantry belonging to the Third Brigade in Kuantung with some artillery were dispatched on the 21st January with orders to observe the line of the Yalu.

"At Liao-yang quarters are being prepared and vehicles collected. Food and clothes are being sent to Fenghuangcheng, and 20,000 Chinese horses have been ordered; 2,000 fresh troops have arrived at Liao-yang.

"On the 1st February our Consul at Vladivostock was told that all Japanese were to prepare to leave.

"The whole of the Russian fleet in Port Arthur (with the exception of one battleship undergoing repairs) have gone out to sea (destination unknown).* Russian forces in the Far East appear to be mobilizing.

"The following information was received from Europe: Russia will form two armies—North and South—and concentrate them in South Manchuria and the Ussuri.

"Russia intends to send the following reinforcements from Europe when necessary, viz., two Army Corps, four reserve infantry divisions and a cavalry brigade; while she is now preparing to send two infantry divisions, one division and one brigade of cavalry, in addition to the above.

"The troops east of Lake Baikal are concentrating in Manchuria and Ussuri.

"The Ninth East Siberian Rifle Brigade is to be converted into a division and a new brigade formed. A draft left at the end of January for the purpose of bringing a portion of the 31st Infantry Division up to war strength.

"The Tsar has entrusted Viceroy Alexiev with full powers. The latter has determined upon war, but wishes to delay until the naval reinforcements under Admiral Virenius arrive, the 3rd Siberian Army Corps is organized, and the docks at Port Arthur are completed."

At this moment—the beginning of February—military strategy did not favour the opening of hostilities. To invade Korea while her northern ports were still ice-bound and her roads about to become impassable would, as events proved, involve many weeks' delay; nor was there any information to show that the occupation of Korea a month later would be more hazardous or undesirable from the military or political point of view. In spite of the fact that,

* This information does not appear to have been mentioned in other accounts. It is also stated in a note to the above that, as a matter of fact, the Russian fleet anchored in Talien Bay on the night of February 3rd, and returned to Port Arthur the next day.

Digitized by Google

in Japan, the army is the senior service, and her chiefs practically monopolized political power —the Premier was a general on the active list, Prince Yemagata (the senior of the elder statesmen) a field marshal—the paramount necessities of naval strategy were recognized. Admiral Virenius was approaching it is true, but he could not reach Port Arthur before the beginning of March. The crucial point was that the Port Arthur fleet had gone out to sea. Its whereabouts and destination were unknown in Tokyo on the 3rd February, and it is significant that at an Imperial Council the following day it was decided to begin hostilities.

With the exception of the statement that Reserve (Kobi) divisions were formed (as well as brigades), the chapter on the Japanese military forces contains no information not already available.

The total number of combatants and non-combatants that took part in the war is given as 1,088,996; of these 999,868 served overseas.

The Japanese Plan of Campaign.

A translation—practically *in extenso*—is given below of the "Japanese Plan of Campaign" as being, perhaps, the most important chapter in the book:—

"The Japanese General Staff realized before the war that, although the Russian Army was some seven times greater than their own, yet the numbers that Russia could employ in the Far East were not greatly superior . . . and would not, in fact, be more than two-fifths of her total force, owing to the necessity for protecting her interests in Europe. Difficulty of supply was another important factor limiting the number of troops that could be employed. Eastern Siberia was thinly populated and comparatively unproductive, while Manchuria could only provide a portion of the forage and rations required. Everything else must be sent from Russia by a single line of railway. Taking into consideration also the still imperfect condition of this line and the interruption caused by Lake Baikal, it could be said positively that more than 300,000 men could not be maintained in the Far East. There was also at this time a considerable amount of unrest in Russia, and this cause further reduced the force that was likely to be sent against us to about 250,000 men, a number about equal to that which we could send from Japan.

"With regard to the Russian area of concentration, although its position was uncertain, yet it must be situated so as to provide suitable lines of advance both towards South Manchuria and the Ussuri region, whichever the Japanese might choose as the field of operations for their main army.

"Although it would seem that reinforcements from Europe and Western Siberia ought first to concentrate at Harbin, yet it seemed more probable that Russia would reinforce the troops already in the Far East than allow us to overrun Southern Manchuria without resistance. (At the end of January the following was estimated to be the strength of the Russian forces in the Far East if mobilized, omitting reserves to frontier troops: 96 battalions, 75 squadrons, 30¼ batteries (230 guns), 8 engineer companies, 1 battalion, 17 batteries, and 1 engineer company of fortress troops).

"If the enemy advanced south we should concentrate our forces as quickly as possible and drive them back. If, on the other hand, the troops already in Manchuria and Ussuri were used to keep touch with us and gradually draw us northwards until the main Russian Army had finished its concentration, then it would be for us to overwhelm their advanced troops before attacking their main army when it advances.

"At the outset our chief object was to bring about the main operations in Manchuria, to search out the enemy's main strength and drive it northwards; while our fleet must defeat their Pacific Fleet and thus obtain command of Eastern waters.

"In accordance with these intentions the operations on land were divided into two periods, and the plan was broadly as follows:—

> "First Period.—The 1st Army to advance from Korea, debouch on the right bank of the Yalu and contain the enemy; the 2nd Army, at a favourable opportunity, to occupy a point on the south-east coast of the Liao-tung Peninsula and establish a base there. The 3rd Army then to land and observe the Port Arthur fortress, and if necessary take it. While the 2nd Army was advancing north in conjunction with the 1st Army, the 4th Army was to land, either between the 1st and 2nd Armies, or on the north-east shore of the Gulf of Pechili; these three armies acting in close co-operation to take Liao-yang.

Digitized by Google

"Second Period.—If the first phase opened in the spring it should be completed by the autumn; the army would therefore winter north of Liao-yang on ground that had been won, rest, and refit. Movements would recommence the following spring, the enemy sought out and crushed beyond hope of recovery.

"Saghalien to be taken at a suitable time during either of these two periods.

"Although Russia's Far Eastern fleet had been increased, her naval strength when relations between the two nations became strained was approximately equal to our own.

"We could not tell whether at the outbreak of war their fleet—or the greater part of it—would—(*a*) assemble in Port Arthur Harbour and await the arrival of reinforcements; or (*b*) seek a decision at once; or (*c*) operate in the Yellow Sea or Sea of Japan and await a favourable opportunity. As the adoption of either (*b*) or (*c*) would favour the Japanese, course (*a*) was the most probable one . . .

"But as every day's delay was so much time gained for the Russian preparations, we decided not to await the result of a naval engagement but to send a powerful force to Korea and capture Seoul, a movement which could be carried out without risk, as our navy could thoroughly guard the Korean Straits. Moreover, calculations showed that if both sides sent a division to Seoul (*i.e.*, at the outbreak of war) we should have a considerable advantage as regards time. Consequently a detachment was to land at Chemulpo immediately after war was declared, occupy Seoul, and deliver Korea from the yoke of Russia, after which one division was to land on the south or east coast of Korea, concentrate in the vicinity of Seoul, and there await the result of the naval engagement. The possibility of the enemy advancing from the north could almost be dismissed, on account of distance and the difficulty of the country.

"Should our navy be successful, a strong force was to be pushed into the north-west portion of Korea, in order to complete the occupation of that country, and obtain the first victory. In other words, the main portion or two divisions of the 1st Army would land on the west coast of Korea and, joining the division previously disembarked on the west coast, advance through the north-west province of Korea into S Manchuria . . .

"If Chinampo be chosen as our port of disembarkation and the district in the neighbourhood of Pingyang as our area of concentration, we should be able to concentrate three divisions (including the division attached to Seoul) before the enemy could do so, but if the ice had not melted, Chemulpo must be our port of disembarkation, and the area of concentration must be changed to the neighbourhood of Haiju. This would involve several days' delay, but it should not be very difficult to concentrate in that area before the enemy could reach it.

"It was decided to disembark the bulk of the 1st Army after command of the sea had been obtained, Chinampo was to be the chief port of disembarkation if ice-free, otherwise Chemulpo. The 1st Army was then to advance, and when it had occupied the right bank of the Yalu the 2nd Army (3 divisions, 1 cavalry brigade, and 1 artillery brigade) was to land—covered by the 1st Army—on the south-east shore of the Liaotung Peninsula at a point as far as possible from Port Arthur, in view of possible interference from the Russian fleet. Takushan was eventually chosen, in order that the 2nd Army might co-operate as closely as possible with the 1st Army.

"The plan of campaign given above was determined before the war began, and the operations during the first period were carried out almost entirely as planned; but with the object of destroying the enemy's fleet the capture of Port Arthur was undertaken, and the length of this siege, necessitated by the stubborn resistance of the garrison, had a great influence upon the operations of the main army. The consequence was the Battle of the Shaho during the second period, and although the enemy's intention was frustrated, yet it must be admitted that, owing to lack of numbers, we did not gain the success that we hoped for . . .

"After the Battle of Mukden Russia's military resources were by no means exhausted: the capacity of the railway had been enormously increased, she had renewed her strength. On the other hand our preparations were very extended and difficult to maintain, while the conquest of Saghalien and the advance in N. Korea could not be carried out, as our fleet was required to meet the approaching Baltic Fleet. However, the victory of the Sea of Japan enabled us to carry out our original plan, Saghalien was occupied, the enemy was expelled from the north of Korea, and our troops there reinforced the army in Manchuria . . ."

It will be noted in the foregoing that: (1) Although the possibility of a Japanese advance from the direction of Vladivostock is mentioned in connection with the choice of the Russian area of concentration, we are not told whether this possibility was ever entertained by the

Digitized by Google

Japanese General Staff. (2) It was recognized before the war that the Russian Fleet would probably remain in Port Arthur until naval reinforcements arrived (see above), but it was, apparently, not considered at that period that this would necessarily involve the capture of Port Arthur: "The 3rd Army . . . was to . . . observe the Port Arthur fortress, and, if necessary, take it." (3) From the comparatively lengthy discussion devoted to the subject it appears as if the occupation of Korea was the essential and difficult thing. It is true that if hostilities began before the ice melted, then the first advance could only take place in Korea; but if the war started after the South Manchurian coast was free from ice, it is not clear (assuming that sufficient superiority had been established at sea) why the occupation of Korea should still be the only initial operation worthy of consideration.

The following are extracts of the summary of the operations described in Vol. I., which precedes the detailed account.

After describing the advance of the 1st Army to Wiju, the employment of the 2nd Army is discussed as follows:—

"Owing to the favourable naval situation it was hoped that it would be possible to land the 2nd Army in the neighbourhood of Talien Wan. At first the Japanese Headquarters had three alternative plans: (1) To land immediately the main army with one swoop in and near Talien Wan, quickly cut off the Kuan-tung Peninsula, and establish a large base there; (2) to land at Ta-ku-shan or to the east of it, so as to act in close co-operation with the 1st Army; or (3) to land in the vicinity of the mouth of the Ta-sha-ho. But as the enemy appeared at the end of April to have about 4 divisions in the neighbourhood of Liao-yang, 2 divisions at Feng-huang-cheng, 2 divisions between Chin-chou and Kaiping, and about 1 division in Port Arthur, Talien Wan was the most suitable place of disembarkation, as calculations of time and space showed that it involved little danger from a land attack, while its position was excellent strategically; it was, however, very dangerous from the naval point of view. Plan (2) was not only unsuitable for disembarkation of troops, but it would cause a delay in the subsequent operations. It had, however, the advantage that it was the least risky, and would have been chosen had not the naval situation permitted the adoption of Plan (1). . . . It had originally been the intention to include a division with mountain guns in the 2nd Army, but as the country round Talien Wan was flat and the resistance of the garrison had to be considered, mountain guns were not included.

"The Imperial Headquarters decided that if Admiral Togo's third blocking expedition was successfully carried out on or before the 30th April, the 2nd Army would immediately land near Talien Wan; if not successful, that the landing would be carried out near the mouth of the Ta-sha-ho.

"On the 22nd April, in consequence of Admiral Togo's decision, it was decided that the disembarkation of the 2nd Army would begin on the 1st May, whatever the result of the blocking expedition.

"The bulk of the 2nd Army (1st, 3rd, and 4th Divisions) assembled off Chinampo on the 30th April, and the first detachment landed on the south-west shore of the mouth of the Ta-sha-ho on the 5th May in conjunction with the third blocking expedition (the date was delayed on account of naval preparations). The 1st Army was instructed to debouch on the right bank of the Sha-ho before the 2nd Army landed, contain the enemy, and so prevent him from advancing south. Contrary to expectation the enemy did not move south from Liao-yang and Anping, and stranger still the Russians near Port Arthur and Chin-chou offered no resistance, so that the landing was easily effected . . .

"The landing of the 10th Division should have synchronized with that of the 2nd Army, but owing to the lack of transports it was delayed until the 19th May; and then, in consequence of the very bad landing facilities, the disembarkation although unopposed was very slow. It was the intention to land another division at Kankyodo; but as our fleet was obliged to watch the Vladivostock Squadron and transports were lacking, this plan was changed.

"As the 2nd Army and 10th Division were now established on the Liaotung Peninsula, it was necessary to prepare to organize one army to advance northwards and another to besiege Port Arthur. The 5th and 11th Divisions were accordingly allotted to the 2nd Army. Previous to this Admiral Togo had reported that he could not clear Talien Wan of mines until the Chin-chou Isthmus had been occupied by the army. The 2nd Army was accordingly directed to attack the enemy in the neighbourhood of Nanshan. Tairen was occupied, and the 5th and 11th Divisions were gradually disembarked; the 1st and 11th Divisions formed

Digitized by Google

the 3rd Army, while the 2nd Army prepared to advance northwards. At this time the main body of the enemy's fleet was lying up in Port Arthur awaiting an opportunity, and could not be neglected. The only method of operating against this fleet was to destroy its base from the land side. Tairen was also necessary as a main overseas base for the Manchurian armies. For these reasons the attack of Port Arthur was decided upon.

"At the beginning of June reports were heard that the enemy were moving south from Liao-yang and Kaiping. The 6th Division was accordingly suddenly added to the 2nd Army . . . The 1st and 4th Kobi Brigades, then in course of formation, were allotted to the 3rd Army. Owing to the continuous activity of a large force of Russian cavalry on the right flank of the 1st Army, and to the necessity for protecting that army's line of communication, a Guard Kobi Brigade (two battalions of which were already on the lines of communication) was formed, and together with three other Kobi battalions were added to the 1st Army. . . . The 10th Division, which was felt to be too weak, was also reinforced by the 10th Kobi Brigade.

"About the middle of June reports were received that the enemy's Baltic Fleet was approaching. . . . The Commander of the 3rd Army was accordingly instructed to capture Port Arthur as quickly as possible.

"About this time Imperial Headquarters decided that the 1st and 2nd Armies and 10th Division must defeat the enemy's main army at Liao-yang before the rainy season in Manchuria began, and in accordance with this object the following plan was laid down :—

"(1). The 3rd Army will be reinforced by the 9th Division and, if necessary, by the 2nd Field Artillery Brigade.

"(2). The 1st Army will push forward at once a force of about 1 division to Tsao-ho-kou, and under cover of this force 21 days' supplies for 3 divisions will be collected at Tung-yuan-pao

"(3). The 10th Division will collect supplies for 20 days for 2 divisions at Hsiu-yen by the 6th July. The detachment at Hsin-kai-ling will co-operate if the situation renders it necessary.

"The 10th Kobi Brigade will begin its disembarkation at Ta-ku-shan on 1st July, and follow the 10th Division.

"(4). The 2nd Army will advance on Kai-ping on the 19th June. After taking it the Army will occupy Ta-shih-chiao and Ying-kou with strong advanced parties.

"Supplies north of Hsiung-yo-cheng will be drawn from sea transport.

"If the above plan can be carried out as arranged each army will advance without interruption on Liao-yang; but if this advance does not progress as anticipated and the rainy season begins, then it will be necessary to remain in whatever positions are reached until the rains are over.

"Imperial Headquarters issued orders in the above sense, and also gave instructions on the 19th June to the 1st and 2nd Armies and 10th Division, that in accordance with the above instructions, the advance on Liao-yang was to be carried out as quickly as possible. The Inspector-General of Communications (General Kodama) was also directed to disembark supplies at the mouth of the Hsung-yo-ho as soon as Hsung-ho-cheng was occupied.

"On the 20th June General Kuroki requested leave to recall the Asada detachment. Imperial Headquarters refused to allow this until the 10th Kobi Brigade had joined the 10th Division, and ordered that no advance was to be made north of Fen-shiu-ling. . . .

"The intention of the 2nd Army to advance upon Kai-ping after Te-li-ssu was frustrated by the difficulties of transport upon the line of communication. . . ."

A History of the British Army. Vol. VII., 1809–10. By the Hon. J. W. Fortescue. 661 pp., with index and vol. of maps. 8vo. London, 1912. Macmillan. 21s. net.

In the present volume of his History of the British Army, Mr. Fortescue is only able to deal with the years 1809-10. This is easily understood when we recollect that the British Army was engaged in active operations not only in Holland and the Peninsula, but also in the Mediterranean, as well as in the West and East Indies.

The book begins with an account of the operations in the West Indies in 1809. The strain on British resources which their possessions in those parts entailed, combined with the

Digitized by Google

unfriendly attentions of rival Powers, was a severe one, and the selection of the best policy to be pursued was no easy matter. Mr. Fortescue explains the courses open to England, and shows how, while the question was still undecided, Napoleon's invasion of Spain so far altered the situation that the French colonies became, to all intents and purposes, the sole object of attack, every effort being made to help and protect those which belonged to Spain. It was not, however, till the beginning of the following year that, by the capture of Guadeloupe, the offensive power of France in the West Indies was practically destroyed.

The next chapter begins with a review of the military problems which faced the British Government at the beginning of the year 1809. The resignation of the Duke of York as Commander-in-Chief, and the difficulty of filling the ranks of the Army, were but two of the many troubles which beset them at home. It is interesting to note that the military authorities came forward at this time with a proposal for absorbing the Militia into the Regular Army. Before, however, the plan which was actually accepted had had time to take effect, war broke out between France and Austria. While the British Government was anxious to aid Austria, uncertainty as to the policy which Prussia would pursue made it difficult for ministers to come to a correct decision as to the best sphere in which to employ the British Army. Mr. Fortescue explains in the clearest way the problem which they had to solve, and he makes it plain that, while concentration of effort in the Peninsula was the right military course to pursue, financial difficulties were insuperable. Fortunately the Government decided to make up the force in Portugal to the strength recommended by Sir A. Wellesley, and to place him in command. They then had to consider how to employ the rest of the Army. Amongst the plans put forward was one for an attack on Walcheren, with a view to the destruction of the squadron known to be in the Scheldt. This scheme, which appears to have been warmly supported by the naval and equally strongly opposed by the military authorities, was finally approved. It seems practically certain that the expedition would have been a failure in any event; but, to have the faintest chance of success, it was essential that it should be despatched while the weather was favourable, should come as a surprise, and be conducted with energy. Unfortunately every one of these essentials was lacking, and friction between the naval and military commanders made matters worse.

Mr. Fortescue maintains that the real mistake made by Ministers was in committing the force to an operation of doubtful success, when by holding it in readiness for a month or two, its quality would have been improved, and a more profitable objective might have been found elsewhere. It is somewhat difficult to accept this view of the case when we remember the state of affairs abroad. As the author himself points out, Austria needed practical support, and it was equally important to encourage the patriotic party in Prussia. While, therefore, we may agree with Mr. Fortescue's conclusion as to the unsuitability of the British Constitution for the purposes of war, we may perhaps be permitted to doubt whether in the given circumstances any other form of Government would have found a happier solution.

From Holland we are taken to the Peninsula, and after dealing briefly with the operations in Catalonia, Mr. Fortescue passes to the events which succeeded Moore's departure. Some fresh evidence throws a new light on the difficulties with which Cradock, who was left in command in Portugal, had to contend, and the important effect of Canning and Frere's blunders which prevented a landing of British troops at Cadiz is fully explained. The following chapter contains an account of the operations undertaken by Wellesley to clear Portugal of the French. The reasons which induced him to attack Soult at Oporto in preference to Victor at Merida are admirably explained. As an example of the study which Wellington gave to tactical methods, and of the care which the author has taken to record details which to many might appear of little or no value, attention may be drawn to the description of the novel distribution of riflemen in the first order of battle, which consisted in the allotment of a company to each brigade, this being, in Wellington's opinion, the best method of combating the tactics of the French.

Mr. Fortescue is particularly happy in his description of the disturbing effect the British Army, backed by British naval supremacy, had on Napoleon's calculations, and he shows how Moore's march to Coruna first led Soult and Ney into the north-west corner of the Peninsula, and then tempted Napoleon to commit the serious blunder of keeping them there in order to close the ports of Coruna, Vigo, and Ferrol to the British fleet before he had conquered Portugal.

The Talavera campaign is next described. As Mr. Fortescue points out, the campaign was, perhaps, more remarkable for the internal quarrels of the generals on either side than for the

Digitized by Google

actual fighting; and while we may agree that the British commander showed himself somewhat impetuous and over-confident, we see that he alone realized the outstanding lesson of the operations, which was that final victory would be practically assured to the army which should first overcome the difficulties of transport and supply.

Mr. Fortescue's account of the general effect of the various expeditions undertaken in 1809 on the Government and the House of Commons is both illuminating and instructive. He notes, as an interesting comment on the qualification of the Commons to deal with military matters, that a reduction of the Royal Wagon Train, on which the transport of the Army depended, was considered the best way to overcome the opposition to the passage of the estimates. Before a return is made to the scene of regular operations in Portugal, Mr. Fortescue devotes a good deal of space to describing the minor operations which took place throughout Spain during 1810, the chief characteristic of which was the futility of such as were attempted by the Regular Spanish troops, and the success of the guerilla bands which now began to make their appearance.

In Chap. 36 a very interesting description is given of Wellington's staff and the methods in which business was conducted. From this we learn that Wellington was in reality his own Chief of the Staff, that he conveyed his orders as to the movements of the army mainly by means of private letters, and that he was very jealous of any intervention by the members of his staff. In the matter of intelligence also he appears to have kept control of the various agencies employed, and to have received their reports himself. Amongst many other interesting details contained in this chapter, the relations existing between the Government and Wellington are examined and discussed. Mr. Fortescue shows that Wellington did Ministers less than justice, and while ready to admit that the Commander-in-Chief may have had grounds for mistrusting them, he contends that the men who, in spite of three military failures—on the Scheldt, on the Tagus, and in the Bay of Naples—boldly took up the reins of Government and still maintained the war, are as much to be honoured as the commander who carried out their policy. An admirably lucid description of the somewhat complicated manœuvres carried out by the British forces in the first half of 1810, culminating in the Battle of Busaco, followed by the retreat to the lines of Torres Vedras, is then given; while the two final chapters of the volume deal with events in the East Indies.

An account of the mutiny which took place in the East India Company's force in Madras, which might have had disastrous effects had it succeeded, is included. It would appear that the disturbance was mainly due to a change of policy on the part of the Company enforced by an unwise and unsympathetic Governor.

An agreeable contrast to the above is the story of the expedition to Java under Sir S. Auchmuty, and of the operations which ended in the capture of that island.

To do justice to such a work as this within the limits of space available is impossible. All that has been attempted here has been to show the ground covered by the volume, the care with which Mr. Fortescue has examined all available sources of information, the pains which he has taken to weigh the evidence thus obtained, and the impartiality which marks the conclusions at which he has arrived.

CAMPAIGNS ON THE NORTH-WEST FRONTIER. By Capt. H. L. Nevill, D.S.O., Royal Field Artillery. 404 pp., with 6 illustrations, 5 maps in pocket, and 9 plans in the text. 8vo. London, 1912. John Murray. 15s.

This volume gives short but clear accounts of all the various campaigns on the North-West Frontier of India which have been undertaken by the British, with tables of the various troops engaged.

The operations of more recent years, commencing from the Hunza-Nagar campaign of 1891, are reviewed, and the more prominent tactical lessons of each campaign are brought out and compared with the principles now laid down in *Field Service Regulations*, Part I.

The book concludes with an anticipation of the conditions likely to be met with in the future, and how modern science may assist us in our next operations.

Apart from tactical lessons, this book is also valuable as a work of reference, and for instructional purposes regarding the geographical and ethnographical features of the North-West Frontier of India.

Digitized by Google

ORGANIZATION.

ORGANIZATION. By Colonel Hubert Foster, R.E. 267 pp. 8vo. London, 1911. Hugh Rees. 3s. 6d. net.

In his preface Colonel Foster explains how his inability to find any work dealing systematically with army organization induced him to compile the present book, and it is unquestionable that the subject has not been handled in such a way as to present any very clear idea of its real meaning and significance. In the work under review the author has confined his attention to giving a general account of organization for war only, for, as he says, the inclusion of organization in peace would open out too wide a field of discussion.

In his first chapter the author explains what is meant by organization and why it is necessary, and he then describes the various kinds of troops which go to form an army, their methods of fighting, and functions in war, these being necessary preliminaries to a consideration of the units and formations of which a modern army consists. As, however, changes have taken place in the British Service since the book was published, it is necessary to warn the reader that some of the information contained in it is not strictly accurate, and we cannot accept the view that it is impossible to group a variety of troops which are mentioned in Chapter 4 under any one of the old heads of the three arms, the effect of which would be to make "command"—which it is the object of organization to facilitate—a far more difficult question than it now is.

The author then explains how, as the result of past experience and of a forecast of future needs, the various units are combined into smaller formations, and how these again are combined into larger formations constituting what are called subordinate commands, the essence of which is that they are capable of independent existence and action. Their administrative services and staffs are also described in sufficient detail to enable one to obtain a good idea of their essential features. The final chapter of this Part explains the object and utility of war establishments, the importance of preserving the original organization of a force, the evils of improvization, and lastly, the meaning and use of an *Ordre de Bataille*.

Part II. deals entirely with British war organization, and is therefore concerned mainly with the Expeditionary Force, which has, however, been modified in certain details, chiefly those connected with transport and the service of intercommunication, since the book was published. The special features of this organization, their object, and the advantages claimed for them, are well explained.

In Part III. the author gives a brief description of the war organization of foreign armies, which, with the exception of that of the United States, follow the same general plan. This Part is followed by a short history of the developments of organization since the introduction of firearms, in which Colonel Foster shows that modern organization dates from the close of the Feudal epoch in the fifteenth century, and that Italy was the country in which it originated, and to which most military terms may be traced. Having first outlined the growth of the earliest regimental organization from the companies of which permanent Regular forces were originally composed, he proceeds to give an account of the evolution of each arm in turn, followed by a description of army organization in the seventeenth and subsequent centuries. A separate chapter deals with the evolution of the Staff and administrative services.

Part V. is devoted to a consideration of the principles of command and the psychological characteristics of armies. The reason for touching on these subjects becomes obvious when it is remembered that the chief object of organization is to facilitate command. The extent to which the method of command has been modified in consequence of the growth of modern armies is explained, and the difference between "instructions" emanating from the supreme commander and the "orders" issued by subordinate commanders is made clear.

An appendix contains an explanation of the way in which military terms came to have their present technical meaning, together with their country of origin and derivation. This appendix forms a very interesting addition to a work which, even without it, is full of much useful information on a subject that must attract every soldier who takes an interest in his profession.

Digitized by Google

POLITICS.

THE MILITARY DANGER OF HOME RULE FOR IRELAND. By Major-General Sir T. Fraser, K.C.B., C.M.G. 119 pp. 8vo. London, 1912. John Murray. 8s. 6d. net.

In this book the author briefly reviews the military history of Ireland from the time the Romans inhabited England to the present date; and, basing his opinions on the experiences of the past, he concludes that it is his duty to draw the attention of his fellow-countrymen to the danger to the Empire involved by the adoption of Home Rule in Ireland.

STRATEGY AND TACTICS.

STAFF WORK. By Colonel Hubert Foster, R.E. 223 pp. 8vo. London, 1912. Hugh Rees. 3s. 6d. net.

The object of this book is to give instruction in the every-day duties which would fall on the commander or General Staff officer of a small force of all arms on service.

The book is, the author explains, the outcome of many years' experience with Militia in Canada, the United States, and Australia.

Much of the contents can be found in *Field Service Regulations*, but the latter is necessarily very terse, and moreover applies essentially to a British division. It is therefore somewhat difficult for a beginner to follow. It is with the idea of smoothing away some of these difficulties that this work is published. At the same time, the fact that British operations will be conducted under the above Regulations has been constantly kept in view.

While the book is very likely to assist students in clearing up points on which they may have been in doubt, it is necessary to caution them that portions are already out of date, owing to recent changes in organization.

Digitized by Google

BOOKS RECEIVED.

STAFF WORK: A Guide to Command and General Staff Duties in Small Forces of All Arms in the Field. By Col. Hubert Foster, R.E. Hugh Rees, Ltd., 5, Regent Street, S.W. 1912. 3s. 6d. net.

A BRIEF HISTORY OF THE KING'S ROYAL RIFLE CORPS. Warren & Son, Ltd., 85, High Street, Winchester. 1912.

BUILDING CONSTRUCTION AND DRAWING. By Chas. F. Mitchell. Elementary Course. Eighth edition. B. T. Batsford, 94, High Holborn, W.C. 1911. 3s.

BUILDING CONSTRUCTION. By Chas. F. Mitchell. Advanced Course. Seventh edition. B. T. Batsford, 94, High Holborn, W.C. 1912. 6s.

STONEWALL JACKSON'S CAMPAIGN IN THE SHENANDOAH VALLEY OF VIRGINIA FROM NOVEMBER 4TH, 1861, TO JUNE 17TH, 1862. By William Allan, formerly Lieut.-Colonel and Chief Ordnance Officer, 2nd Corps, A.N.V. Hugh Rees, Ltd., 5, Regent Street, S.W. 1912. 6s. net.

ACTIVE SERVICE POCKET-BOOK. By Lieut. Bertrand Stewart, West Kent (Q.O.) Yeomanry. Fifth edition. William Clowes & Sons, Ltd., 23, Cockspur Street, S.W. 1912.

REINFORCED CONCRETE CONSTRUCTION. Illustrated. Advanced Course. By M. T. Cantell, LICEN. R.I.B.A. E. & F. Spon, 57, Haymarket, S.W. 12s. 6d. net, 13s. post free.

Digitized by Google

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

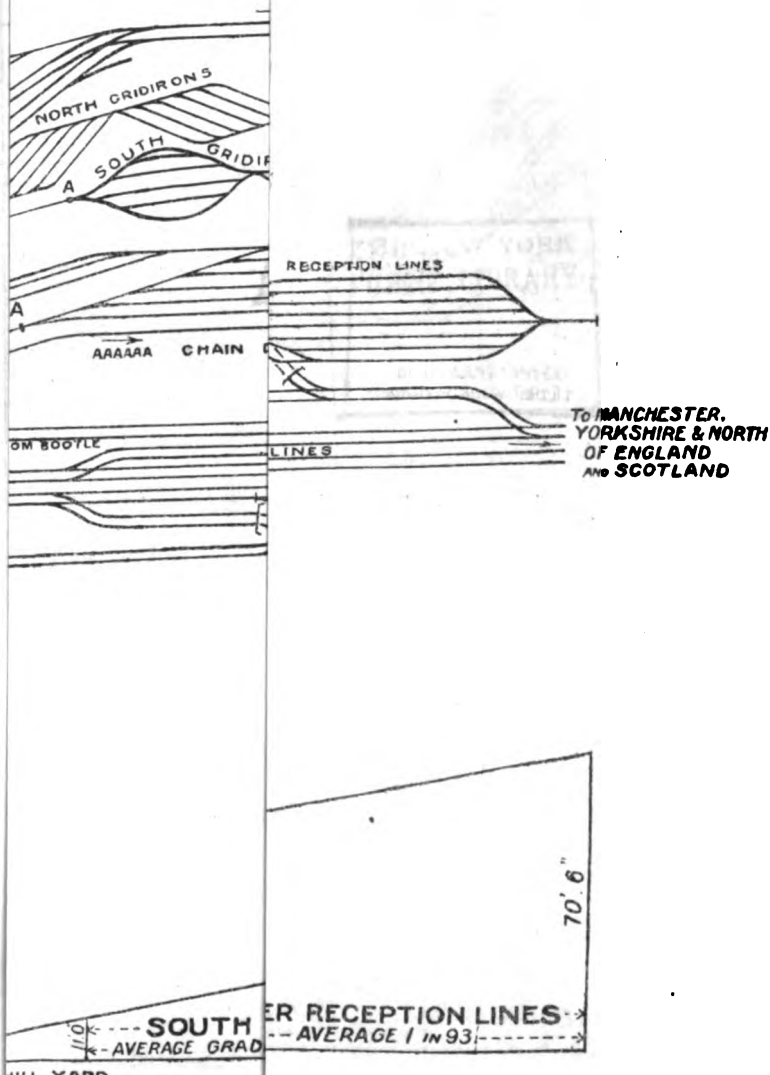
Digitized by Google

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

ON, EDGE H

LING AND SORTI



LONGITUDINAL SEC

Digitized by Google

THE NEW YORK
PUBLIC LIBRARY

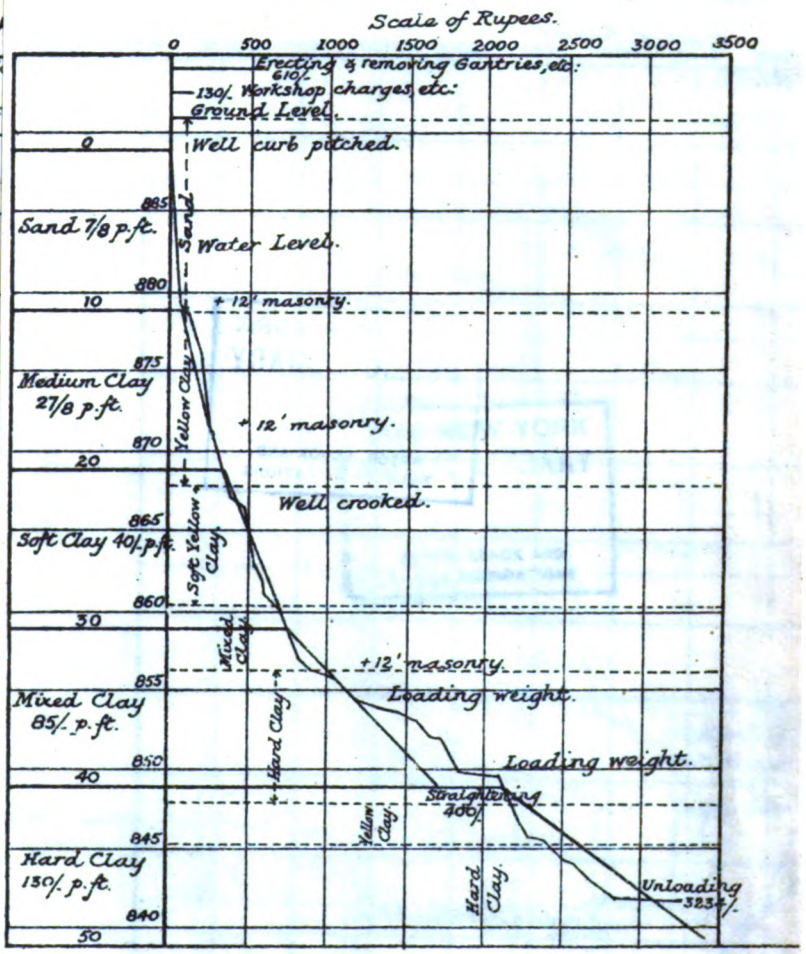
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

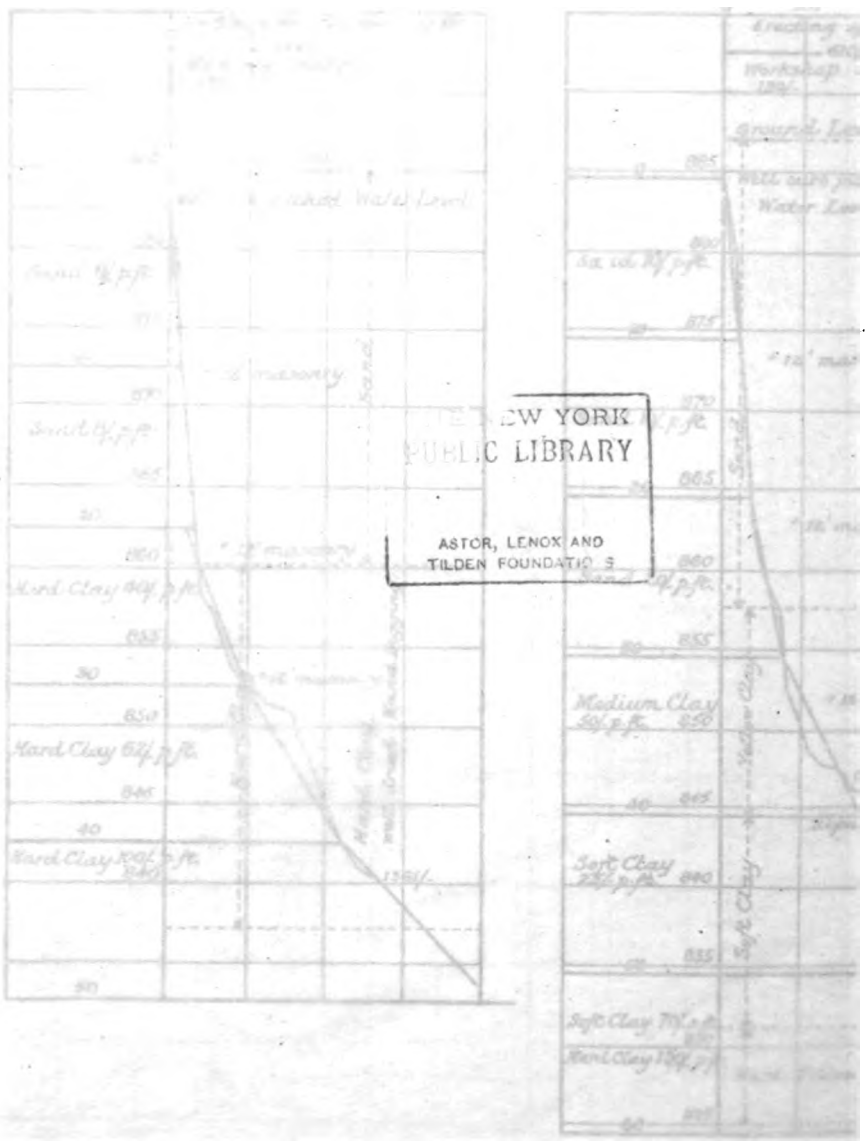
L No 2.

Scale of
1000 1500
removing G
harges, etc:
zl.
ched.
L.
sonry.
sonry.
masonry.
Gantry washe
+ 1
r to Gantry
650/-
Clay, we

WELL No 4.



Digitized by Google



NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Digitized by Google

NOTES ON BRIDGE REPAIRS.

By Capt. W. N. Borton, R.E.

How many of us when faced with the problem of repairing "on paper" a demolished bridge, whether on manœuvres or at war games or winter schemes, have not proposed to obtain materials from neighbouring buildings—often without seeing the buildings in question or examining what materials could actually be obtained from them? The object of these notes is to consider this subject.

In the *R.E. Journal* of June, 1911, Major Matheson, writing on bridge demolitions, proposed two formulæ for calculating the charges for girder bridges, both railway and road, which will be found very useful on manœuvres or on service. The basis of these formulæ was the fact that the Civil Engineer who designed the bridge made it to carry a definite load, and in order to do so was obliged to use a more or less definite amount of "stuff," which would require a more or less definite amount of explosive to destroy it. The only variables were span, depth of girder, and number of girders, all of them easily measured. The formulæ, though very general, were sufficiently accurate for use "in the presence of the enemy," in which circumstances we are ordered to add 50 per cent. to the amount of our calculated charges. Some such simple formulæ would be very useful also to save calculations in hasty repairs to a broken bridge.

Suppose then that we are confronted with a demolished bridge; it may be that the gap produced is of a simple nature and easily crossed by a normal trestle bridge; then all we have to do is to rip up the floors of some neighbouring buildings and having obtained a supply of nails wire or rope to put together plank trestles made from floor joists, and to use other joists as road-bearers, and floor boarding for the bridge floor, and over we go.

But we must remember that the enemy's pioneers will be experienced in bridge repairs as well as in demolitions, and we must therefore expect him to select, for demolition, a bridge which will be relatively difficult to repair; subject of course to strategic and tactical conditions. Furthermore he will be anxious to husband his explosive, and will therefore make for bridges with long spans, in which an effective gap can be produced with much smaller charges than are required for a bridge consisting, for example, of a number of short-span brick arches. In fact we shall frequently be confronted with a demolished bridge whose spans are greater than the length of timbers which one can obtain from an ordinary house floor, and in which special conditions prohibit the use of intermediate supports, even in

Digitized by Google

war time. Example.—A main road bridge crossing a double line of rails in a deep cutting; the demolished bridge consisting of two 24-ft. span brick arches, the central support of which has been blown down at a depth of 30 ft. below the roadway. It is desired to use both the railway and the road for army communications.

If, as in the above case, we cannot get across with simple floor joists and we are not permitted to block the roadway underneath with intermediate trestles, we must construct some form of girder.

If we turn now to the roofs of our buildings, we find in the roof trusses ready-made girders of sorts, which can be removed and used intact as bridge girders. It is proposed in the following examples to consider how best they can be arranged for this purpose. The objection may be raised that, in order to get at the roof trusses, the whole roof has got to be stripped. This is so, but it will perhaps not take so long as one would at first suppose, and most of the material so obtained, viz. purlins, rafters and boarding, will be required for our bridge.

It may here be remarked that practice in "house breaking" would form very valuable training for R.E. Companies on the somewhat rare occasions on which War Department buildings or barracks are condemned and pulled down.

In the following examples the figures for weights of roof materials and the distribution of loads on the trusses have been taken from Major E. N. Stockley's "Notes on Roofs," recently published as a R.E. Professional Paper.

Considering the loads on roofs of small span we see, from Table III. of the above-mentioned "Notes on Roofs," that roofs may be divided into several classes, *e.g.* temporary roofs, light roofs, ordinary roofs, heavy roofs. For purposes of rapid calculation in the field we want a standard roof, and we might therefore take the "ordinary" figures. But on the other hand we must remember that we may come "up against" the "jerry builder," and it will therefore be better to adopt the figures for light roofs, *i.e.* asbestos slates on 1-in. boarding, as our standard. Here we have a total working load of 30 lbs. per square foot of roof *surface*, made up as follows. Roof covering and boarding 6 lbs., rafters, purlins and trusses 4 lbs., workmen *or* wind 20 lbs., total 30 lbs.

Omitting the 4 lbs. for purlins, etc. (we will show why later), we get 26 lbs. per square foot of roof surface measured on the slope. Measured in plan, the load would be greater per square foot, say 30 lbs., and if we deduct the weight of boarding as well as purlins we might take 26 lbs. per square foot of covered area as the load due to slates and workmen, to be borne by the trusses.

The spacing of the trusses will vary from about 8 ft. to 12 ft. centre to centre. Let us adopt 8 ft. as our standard, anything over that will mean stronger trusses, and therefore greater safety. (A common spacing in British barracks is 11 ft.). Then the load borne by each

Digitized by Google

truss will be $26 \times 8 = 208$ lbs. per foot-run of span. It should be noticed that this figure holds good whatever the span, and with slight modifications could be adopted even for the largest span steel roofs—always provided that the loads are applied at the correct points on the truss.

Let us now consider what load the roof trusses have to bear when used as bridge girders.

Taking infantry in fours to weigh 5 cwt. per foot-run = 560 lbs. per foot-run *live* load = 560 + 50 per cent. = 840 lbs. per foot-run dead load, we see that four trusses would carry

$$208 \times 4 = 832 \text{ lbs. per foot-run.}$$

Therefore provided the loads are applied at the ordinary position of the purlins, and provided the original spacing of the trusses in the roof is 8 ft. or more, four roof trusses will carry infantry in fours crowded, over the whole span of the truss whatever that span may be.

It will be remarked that no allowance has been made for the (1).
weight of superstructure on the trusses of the bridge, but it will be remembered also that the weight of purlins, rafters and boarding was omitted in considering the loads on the trusses in the roof. Taking this at 4 + say 2 or 6 lbs. per foot for the four bays of roof it will give a weight of $4 \times 6 \times 8$ ft. = 192 lbs. per foot-run of four trusses and 180 lbs. is an ample allowance for the superstructure of a bridge for infantry in fours.

Sometimes it will be convenient to load the trusses at the purlin points, and sometimes it will be more convenient to carry the bridge floor along the tie-beam.

As an example of the first case, a brick arch over a canal has been demolished by charges at each haunch. The original clear span was 18 ft. and it is proposed to repair it with four kingpost trusses of 24-ft. span. The nature of the gap produced is shown in *Fig.* 1.

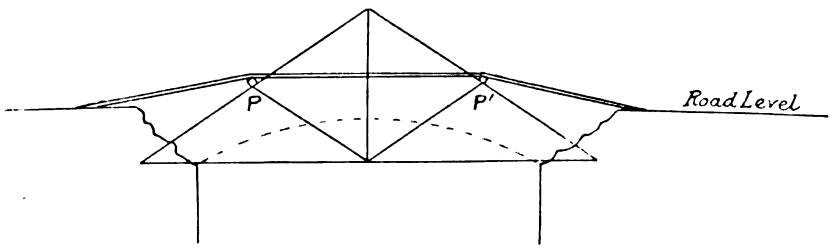


FIG. 1.

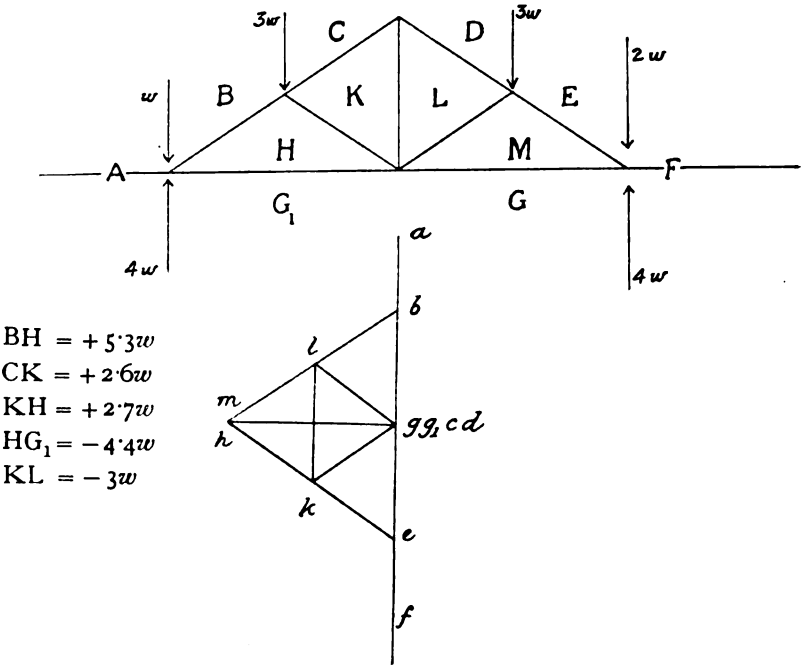
The proposed position of the trusses is shown in outline, two trusses being placed side by side on each side of the roadway. If now a pair of road transoms are fixed at PP', we can get across very conveniently, with a centre span of about 12 ft., and two other spans of about 8 ft.

Digitized by Google

Sometimes however it will be more convenient, as in the case of a girder bridge in which the girders have been cut and dropped into the gap without damaging the piers, to support the roadway directly on to the tie-beams of the trusses.

We will now consider this case; the point to be looked to, especially in timber trusses, is that members which were designed to take compression are not subjected to tension, or failure will probably occur at the joints.

Fig. 2 shows the loading of the truss in the roof and the diagram of stresses in the various members.



BH = +5·3*w*
CK = +2·6*w*
KH = +2·7*w*
HG_1 = −4·4*w*
KL = −3*w*

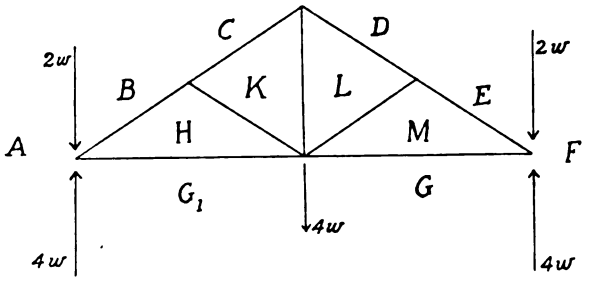
FIG. 2.

The total load on one truss is taken as 8*w*, and the table on the left of the diagram shows the stresses in each member + for compression −for tension. *Fig.* 3 shows the loading and stresses on the truss, when the same total load of 8*w* is applied to tie-beam.

From this we see that when the load is applied at the tie-beam, instead of on the principal rafters, (1) there is no stress in the strut KH. (2) the only members in which the stress is increased are CK and KL. CK will be of the same section as BH and it is not now greater than the original BH, so KL may be taken as the weak point in the truss, and $\frac{KL_1}{KL_2} = \frac{3}{4}$, and, as we have shown that to carry infantry in fours four trusses were formerly required, we now want $\frac{4 \times 4}{3} = 5{\cdot}3$ say six trusses.

Digitized by Google

Therefore six timber kingpost trusses will carry infantry in fours, whatever the span may be, when the load comes directly on the tie-beam. (2).



BH = +3·6w
CK = +3·6w
KH = 0w
HG = −3w
KL = −4w

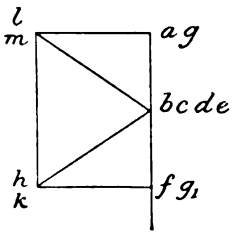


FIG. 3.

It will be remarked that since there is now no stress in the member HK, the principal rafter can no longer be considered as supported in the middle and the unsupported length will be double, and this member will be liable to buckle either upwards or sideways. This can be got over by passing a few turns of wire round the truss above the purlin cleat and under the tie-beam, and windlassing the returns up tight so as to put a strain on the member HK. Also, as there are now no purlins, the three trusses on each side of the bridge should be braced together at intervals up the principal rafter, so as to prevent the danger of side-buckling.

The roadway can be supported on to the tie-beams in two ways (1) by placing a pair of transoms at the centre of the span (these transoms can be made of the roof purlins), and bridging across this gap with common rafters or, better, with floor joists. (2). By placing the floor joists at close intervals along the tie-beam and across the line of the bridge, and covering these with two layers of boarding, the lower layer lengthways along the bridge, and the upper layer across the bridge. This latter method puts a transverse stress on the tie-beams which would therefore have to be calculated; but as the tie-beam is for convenience of joints, usually made of unnecessarily large scantling, it will probably be strong enough. Take the case of a 24-ft. truss which might have a tie-beam of 6″ × 4″, if there is no ceiling.

Digitized by Google

Then using the short formula $bd^2 = \frac{WL}{133}$ for the six trusses

$$6 \times 4 \times 6 \times 6 - \frac{W \times 12'}{133}$$

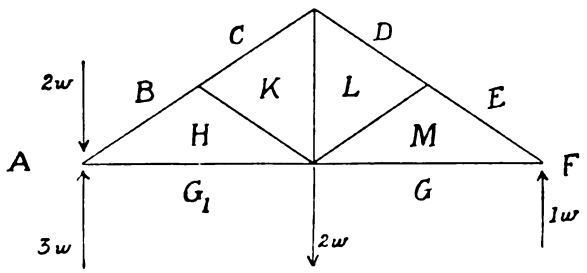
$$W = 9,576 \text{ lbs.}$$

Infantry in fours was, we said, 840 lbs. dead load per foot-run, say 900 lbs. with roadway. Load for 12-ft. run will be 10,800 lbs. so the tie-beams are not quite strong enough, but practically, being continuous over the whole span, they could be regarded as "half fixed" and therefore amply strong. If there is a ceiling, the scantling would probably be about $9'' \times 4''$.

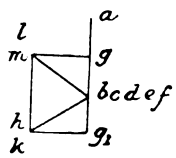
The maximum concentrated load that can be taken by the bridge will vary with the span.

(3). In the above case it would be $12' \times 560 = 6,720$ lbs. $= 3$ tons live load.

It may be well to see what happens when only part of the bridge is loaded. *Fig.* 4 shows the case of a load of infantry in fours over half the span, the load being directly on the tie-beam. The same lettering and units of load are used as in *Figs.* 2 and 3.



BH = + 3·6w
CK = + 3·6w
KH = 0w
HG = − 3w
KL = − 4w



BH = + 1·8w
CK = + 1·8w
KH = 0
HG = − 1·5w
KL = − 2w

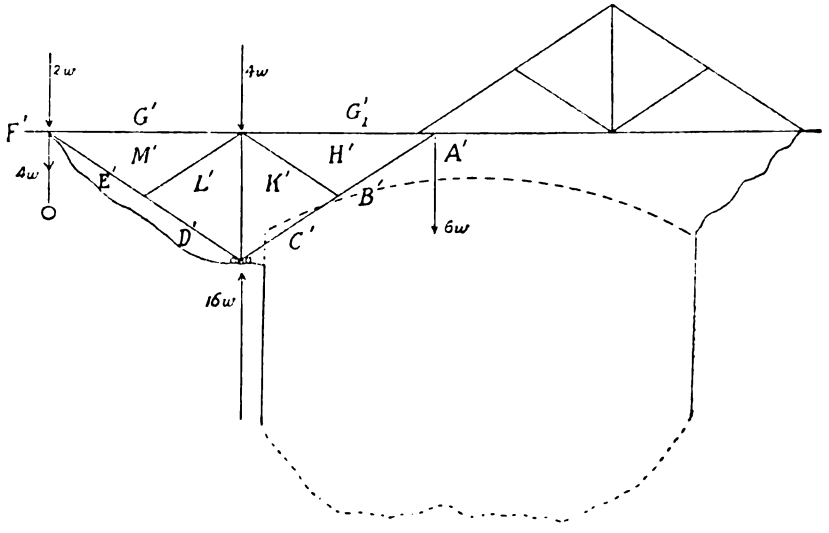
FIG. 4.

On the left of the diagram are the values from *Fig.* 3, while on the right are the new values showing that all the stresses are of the same sign but half the value, so the bridge is uneffected by partial loading.

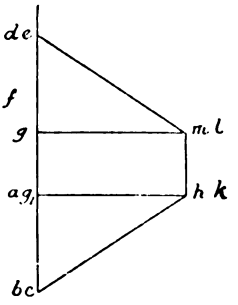
(4). It will often happen that we shall be unable to find trusses of sufficient span to get across the gap in one step, or we may find a number of trusses of small span on the site of a building in course of construction, and may want to use them to save the time which would be required to dismantle a roof of larger span. We could in these circumstances use some of our trusses as cantilevers on one or

Digitized by Google

both shore-ends, with a central span of other trusses used as simple supported beams (*Fig.* 5).



BH = +5·3*w*
CK = +2·6*w*
KH = +2·7*w*
HG_1 = −4·4*w*
KL = −3*w*



B'H' = +11*w*
C'K' = +11*w*
K'H' = 0
$H'G'_1$ = −9·2*w*
K'L' = +4*w*

FIG. 5.

Fig. 5 shows trusses used as cantilevers for the left half of the span and as supported beams on the right half. The stress diagram gives the stresses in the cantilevers, and comparing them with the stress in the similar members in *Fig.* 2 we see that

$$\frac{BH'}{BH} = \frac{11w}{5{\cdot}3w} = 2{\cdot}07$$

or

$$\frac{HG'}{HG} = \frac{9{\cdot}2w}{4{\cdot}4w} = 2{\cdot}09.$$

In *Fig.* 2 we saw that we required four trusses, and as the unit "*w*" (5). is the same we now require for the cantilever span

$$2{\cdot}09 \times 4 = 8{\cdot}36 \text{ say } 9 \text{ trusses.}$$

Total for the bridge 9 + 6 = 15 trusses as against six if we could have got them of sufficient span for the whole gap.

As before, the principal rafter must be secured against buckling.

The nine trusses can be spaced equally across the width of the

Digitized by Google

roadway, and we shall therefore require no transoms or joists, but can nail our boarding direct on to the tie-beams.

The anchorage for the cantilever span will be easily arranged. The pull is $4w = \frac{1}{2}$ the weight of infantry on over the whole span, or, when the load is coming on from right to left in *Fig.* 5, it will be a maximum of $6w$ (always provided that the two sets of trusses are of the same span).

It should be specially noticed that the stress in KL, the kingpost, is compression and not tension as before. With timber trusses this will not matter as far as the joints are concerned, but it may be as well to consider the kingpost for buckling. The length of the post is about the same as the strut KH and we saw in *Fig.* 2 that KH takes $2{\cdot}7w$ with four trusses, therefore nine kingposts will be easily able to take $4w$ which is less than twice $2{\cdot}7w$ as the scantling of the kingpost will be slightly larger than that of the strut.

If, however, the kingpost is an iron rod, as sometimes happens, it will not do at all and a special strut each side of the rod will have to be introduced to take the weight GG_1. The large amount of pressure DC should be noted and provided for in the footings.

Before going on to discuss steel roofs it may be as well to summarize the conclusions to which we have so far come. These are :—

(1). If loads are applied to the principal rafters in the normal position of the single purlin, then

Four timber roof trusses will carry infantry in fours crowded, over the whole of their length. N.B.—Original spacing of the trusses in the roof must not be less than 8 ft.

(2). If loads are applied to the tie-beams, six trusses will be required to do the same work.

(3). Kingpost trusses if loaded as in (2) above will take a concentrated load equal to half the weight of infantry in fours over their whole span.

(4). Partial loading does not matter.

(5). Trusses can be used as cantilever shore ends with a central girder. If all the trusses are of the same span, then with nine trusses at each end and six in the middle, total 24, we can bridge a *clear* span of twice the length of the trusses, or three times that length, counting in the slope of the abutments (*Fig.* 5).

We may now pass on to consider roofs having wrought iron on steel trusses. Steel trusses are becoming more commonly used every year even for moderate spans, and for the larger spans are almost universal. For our purpose steel trusses will offer several advantages over wood.

(1). They will be more likely to be of sufficient span to be really valuable.

(2). They will often be found in single storey buildings, and often used without a ceiling, which will greatly assist in selection of suitable trusses and in dismantling from the roof.

Digitized by Google

(3). They are generally riveted, but divided up into portions of 20-ft. length for convenience of transport, these portions being secured by bolts so that they can be broken up into convenient lengths for carrying from the building to the site of the bridge.

On the other hand they offer certain disadvantages, viz. :—

(1). Difficulty of securing the roadway and the cross bracing of wood to the steel work.
(2). Great variety in design and spacing.
(3). The unit truss is of considerable weight.
(4). Not generally economical unless the load is applied on the principal rafters.
(5). Liable to buckle sideways in launching.

We saw that with timber trusses the thing to avoid is reversal of stress in the members, especially those normally in compression. With steel trusses however the compression joints and members will usually take tension equally well, but the tension members are quite unsuited to take compression. Consequently it will generally be advisable only to load the trusses at the points which were designed to take a load on the roof. In fact it will require careful consideration before we carry the roadway directly on the tie-beams, although we have seen that for many classes of gap this is the most convenient (though uneconomical) method with timber trusses.

Iron trusses of large span are designed to carry either permanent load (roof material and purlins, etc.) + workmen, or permanent load + wind pressure, the higher value being taken in the design of each individual member.

For our purpose, however, the strength to resist wind pressure may be neglected, and we can take, as before, the load due to workmen which is to be equated to the reduced live load (whether infantry or concentrated) to be borne by the bridge trusses, in order to find the requisite number of trusses. But as we are now dealing with trusses of considerable span (which means weight) we shall be well advised to seek economy, and we will therefore try for a more accurate formula.

If we adhere to our unit roof load of 26 lbs. per foot-super of covered area, then suppose the spacing of trusses was 10 ft. we get $26 \times 10 = 260$ lbs. per foot-run.

The equivalent dead load of infantry in fours was, we said, 840 lbs. per foot-run, therefore for 10 ft. we require $\frac{840}{260} = 3{\cdot}23$ trusses.

Substituting "S" for 10 ft. we get

$$N = \frac{32}{S}$$

where N = the number of trusses required to carry infantry in fours (on the principals) and S = the original spacing of trusses in the roof before dismantling.

Digitized by Google

If owing to the nature of the gap we wish to carry the load on the tie-beam, we must draw two stress diagrams, one for the original loading and the second for the proposed loading; and so, finding the stress in the most hardly used member, establish a new value for the strength of the truss, and equate this to the bridge-load in order to find N.

Lastly a few remarks on selecting suitable roofs.

Go first for the roofs of large buildings which will have a large number of trusses of equal span and pitch. The most likely type of buildings will be warehouses, workshops, breweries, railway goods sheds, motor garages, skating rinks, drill halls. If possible select a building of only one storey and with no ceiling. Here we can see what we shall get before we start work, and we shall cause less despondency among the inhabitants, remembering that an Englishman's home is his castle, as is also that of any other nation.

In attacking the roof a hole must first be broken through near the ridge, and through this a line of Sappers would be extended along the ridge at about 2 yards interval, armed with pickaxes. They would work down the roof, stripping off slates and boarding and throwing all over the eaves. Rafters would then be removed and the ridge board and purlins of the first truss, and the top of the truss would be secured with guys. If convenient the truss would then be lowered inside the building and carried away through the doorway by a party of infantry, or if the door is too small, the truss must be pulled out over one of the outside walls. This will be more easily done if a hole is made in the arch over a window, so that one end can be lowered to the level of the window sill before the other end leaves the opposite wall plate.

Riveted steel trusses are usually put together in lengths of about 20 ft., which lengths are afterwards bolted together to form the truss; they can therefore easily be broken up into these lengths for more easy transport from the building to the bridge site.

The following example of handling steel roofs will perhaps be of interest. A firm contracted to supply and erect the steel work of a gymnasium consisting of eight 40-ft. steel roof trusses carried on 14-ft. stanchions. The whole work of erection was done by three men, one of whom was a professional "erector," the second was a carpenter and the third a casual labourer picked up on the spot. The stores used were a 40-ft. derrick spar with 2-in. wire rope tackle and a small winch, a ladder, spanners, and crowbars. The work took about a fortnight (say 300 men-hours).

Digitized by Google

MECHANICAL TRANSPORT FOR MILITARY PURPOSES.

By CAPT. R. K. BAGNALL-WILD, LATE R.E.

MECHANICAL TRANSPORT is now recognized as a necessity for a modern army operating under normal war conditions, and the type of vehicle best suited for military purposes is generally considered to be an internal combustion engined lorry, capable of carrying useful loads of from 30 cwt. to 5 tons.

Many experiments have been carried out with other types of vehicles, including tractors and heavy traction engines. An immense amount of time and energy has been expended on this type question, and many European military authorities have drawn up detailed technical specifications for lorries to meet their requirements.

The most important point, however, is that of supply, and this question has until recently received but little attention. England, her colonies, and other countries have each their own problem to solve, and, before submitting suggestions as to a solution, the conditions must first of all be reviewed.

The number of lorries that would be required in England for the Regular Army for war purposes, exists in the commercial world, but the military ideal lorry is not to be found in general use. The present subsidy scheme has been put forward to encourage the general public to purchase and use lorries specially built to W.D. specification, but so far the results have not been satisfactory. Manufacturers have not responded as a body, and for these reasons, (1) they are at present fully occupied in turning out standard vehicles to the full capacity of their works, (2) a new type of lorry involves heavy initial expense, (3) the military type costs more to produce, (4) many details required by the W.D. are not wanted in commercial work, and consequently this lorry is difficult to sell even taking into consideration the amount of the subsidy which goes to the user.

If this comparatively cheap method of producing suitable vehicles fails, at least two alternatives remain, one to purchase lorries entirely built for war purposes (the subsidy specification is only a compromise as regards design), or to use what exists. If this latter alternative is adopted the expense in times of peace is reduced to a minimum, but the spare part difficulty has to be faced. This difficulty of supplying spares for a fleet of lorries in the field is enormous, and when that fleet

Digitized by Google

consists of a variety of types or rather of a number of types, where vehicles of the same general design differ largely in detail, the task of supply of spares is almost impossible.

Manufacturers hold large stocks of spares, which would be available, but the trouble lies in identity. It is a comparatively simple matter for the owner of a small fleet to get his spares, he knows the date and identity of each of his vehicles, the manufacturer also has similar records; but imagine the task of an officer in charge of a fleet which has been thrust into his hands and which he hardly knows by sight. His demands for spares have to be transmitted through a tortuous channel to the manufacturer, and the spares have to travel back by a similar route. If anything he wanted ever reached him, he would be fortunate.

What would happen under these circumstances? The transport authorities would have to provide an additional number of vehicles to replace casualties, and with the exception of roadside repairs no overhauling or replacement of worn parts could be attempted. There are enough lorries in England to fulfil this programme within reasonable limits. It has the advantage of being cheap in peace time but extravagant in war.

In actual working a great deal could be done to reduce undue waste in war, and the number of casualties at any rate during the first few months reduced to a minimum.

In peace time lorries can be selected for purchase on the outbreak of war. The age should not exceed eighteen months to two years. Sections of each transport company can be formed of lorries of one type and make. The location of spares in times of peace can be ascertained. For a small annual subsidy fee owners can be induced to keep their vehicles in a good state of repair. Further, a reserve of lorries should be noted for replacement of casualties as the war progresses.

There is an important point which must not be lost sight of in selecting vehicles, and that is their peace duties. In war time the civil population must be fed and a number of lorries are required for the transport of food. It is of course possible to utilize the better and newer vehicles for the Army and to substitute older ones for civil purposes, but these arrangements must be made in peace time.

It is thought that by these means a very serviceable and cheap supply of lorries would be available on the outbreak of war, but the scheme has, as already pointed out, the disadvantage of involving difficulties as to the supply of spare parts, and most certainly does not produce vehicles that would be most suited for military purposes

Another state of things has to be faced by a country or colony where civilian vehicles do not exist in sufficient numbers to meet military needs.

In Germany, for example, a heavy subsidy is being paid to induce

Digitized by Google

civil firms to adopt more largely mechanical transport. In this case the military authorities are in a position to dictate as regards type. They have only to deal with home products, as the heavy duty imposed practically excludes vehicles of foreign manufacture. Also the subsidy is so substantial that competition is practically *nil*; the market is therefore confined to vehicles suitable for military purposes.

This is a very costly method of producing the required number of lorries, but it has two advantages: the one that a military type is manufactured, the other that the Government is aiding the general commercial welfare of the State by encouraging a cheap and rapid means of road transport at the expense, of course, of the amount of the subsidy.

There is yet another condition of affairs that requires consideration. Take India for example. No lorries are manufactured and but few exist in the country. This example is worthy of consideration, though possibly lorries are not so essential for general military purposes in India. Local transport by bullock cart, etc., is extraordinarily cheap, and many doubts have been expressed as to the possibility of competing with mechanical transport with financial success. There are, however, figures availiable which prove that in many cases the lorry can be run at a profit. For example, take the Federated Malay States where an extensive goods and passenger service has been in existence for some years and has proved a success.

As far as India is concerned capital outlay is needed. Private enterprises may be encouraged by state subsidy and here, of course, the State would have the control of the type of vehicle used.

The number of vehicles required for a colonial army is not very great, and at first sight it might seem that a suitable type should be purchased and used to best advantage in times of peace. This leads up to a solution the whole problem, not only for India but for all countries.

All subsidy schemes so far in operation and methods of enrolling existing commercial type vehicles are but half-hearted; they do not produce the required article, they are more or less costly, and in some cases very far from achieving even the hoped-for result.

This would seem to show that the matter should be treated on entirely different lines, and that the vehicles should be purchased by the State. Such a scheme involves capital, and may on first sight appear to be rather a difficult proposition. It would be obviously impracticable to store up a large fleet of lorries using only the small proportion, which would be required for military purposes in times of peace. At the end of every seven or eight years the whole of the vehicles would have to be sold as obsolete and practically useless—they would fetch little more than scrap value.

It is clear therefore that these war lorries have to be used in times

Digitized by Google

of peace, and the following scheme is suggested as being a practical way of not only utilizing them, but also of doing so with a fair probability of financial success. There are many examples of State-owned enterprises :—State railways; the Post Office; telegraphs, telephones, etc. Why not State-owned transport companies ?

Such a policy would result in a highly trained transport service. Every officer and every man would be fully exercised all the year round in duties which would be practically the same as under war conditions. Every vehicle would be constructed exactly to military specifications. Spare parts would have to exist in peace, and would be available for war with practically no change in *régime*. To a transport officer such a condition of things would be ideal. Granted that from the executive point of view the idea is as near perfection as possible, it is then necessary to consider how the treasury would be affected, and also what would be the result from the commercial standpoint.

Existing transport companies would have to be considered, and in due fairness to them, a scale of minimum rates would have to be agreed upon.

These companies would argue that there is no room for anybody else, but this is not so at the present time. In England we have several old-established firms of carriers, formerly employing horses, now almost universally adopting lorries. These firms are increasing their fleets daily. New firms are springing into existence with increasing rapidity. Manufacturers cannot produce lorries fast enough to meet the present demand. These facts surely prove that there is room for more ; they further prove that mechanical transport is being run at a profit. At the present time the Army transport costs the British public a large sum of money per annum, though Mechanical Transport has proved more economical than horses. A State transport company would save this amount, could be made to produce money, and would result in the most perfect military transport system imaginable—suitable vehicles, and fully trained officers and men.

It may be argued that State methods of control are costly as compared with those adopted by civil firms—even admitting this possibility, it would still be feasible to run the State transport at a small profit or at the worst at no loss.

The amount of capital is not excessive, and for the present purpose may be assumed to be about £1,400,000, probably less when purchasing in large numbers, and this amount would be spread over a number of years.

To ask English manufacturers to produce the number of vehicles which would probably be required in one year would unduly disturb the output required for commercial purposes, and, unless a heavy import duty were imposed, would give an undue advantage to foreign manufacturers. It would be more advantageous to spread the

Digitized by Google

production over say three or four years, and this would facilitate the organization of the carrying service.

The administration of such a company would at first be no light matter. Services would have to be arranged, and a close relation established with the firms who have goods for transport. Once organized, the working becomes almost automatic.

The total number of vehicles available for general commercial transport purposes would depend on the number that would be used for Government transport. It is natural in organizing such a company that the Government should be the first to benefit. Many departments require transport, and it is obvious that it would be economical from the State point of view to effect the same at cost price by the State transport company. Here again the gross profit that could be derived would be reduced in accordance with the extent to which the vehicles were used for Government purposes, though on the other hand a saving to the State should result as compared with cost involved under existing methods.

Some idea of the annual cost of the scheme may be derived from the following figures :—

Annual cost of one lorry of 3-ton carrying capacity :—

	£
Depreciation at 15 per cent. on chassis, viz., on £600 ...	90
Depreciation at 20 per cent. on the body, viz., on £40...	8
Interest on capital outlay at 5 per cent. on £640 ...	32
Tyres	112
Petrol	90
Driver	100
Lubricants and lighting	25
Repairs and maintenance	25
Garage, etc	20
	£502
Annual mileage	18,000
Rates obtained, 1/- per mile	£900

Allowing for lost mileage a considerable margin remains for overhead and administration charges.

The necessary organization to a certain extent already exists. Troops are quartered in many industrial centres :—London, Manchester, Leeds, Birmingham, etc. In such centres road transport is on the increase, and could readily be further developed. Co-operation with the Post Office as regards road mail services would assist to a large extent and haulage could be organized between depôts at the important towns.

Much has been said about the possibility of utilizing motor omni-

Digitized by Google

buses ; they are, however, the most unsuitable type it is possible to select. Formerly the London bus was a genuine 3-ton chassis ; to-day, the bus is constructed to take a body which has a platform area equal to that of a 3-ton chassis, but it cannot and is not required to carry this load. A bus body weighs at the outside 20 cwt., the load is 34 passengers or a little over 2 tons ; it is required to travel on first-class roads and to fulfil conditions which in no way coincide with those necessary for goods haulage. In other words the commercial chassis can carry 3 tons of useful load in addition to the body, whereas the bus chassis cannot, although the available platform area of the two types is the same. The State transport company could not therefore entertain a town passenger-carrying proposition with any reasonable prospect of success. The lorries would be as unsuitable for bus work, as the bus chassis is for general haulage.

In the colonies conditions as a rule are not so favourable as in England. Roads are not so numerous and often are not equal to English roads as regards their capacity for mechanical transport.

The main consideration in this case is that of cost, and here there are many parallel examples. Take the Sudan Railway. This can hardly be said, up to date, to be a financial success judged as a railway company, but the Sudan Government is apparently prepared to run their railway at cost, or even below actual cost in order to open up the country. In other words the great increase in trade and general improvement in the financial condition of the country is brought about by the greater facilities for transport afforded by the railway—a small loss in one department results in a general financial gain on the whole, which would be otherwise unattainable.

This reasoning applies to mechanical transport, especially in India. If the Government of that country operated a system of State-owned lorries, many ends would be served. The military needs would be met, increased facilities for rapid transport by road must mean an advance in commercial prosperity. Granting that mechanical transport can only be run at a loss as compared with bullock haulage, though this statement is strongly disputed, surely the gains outweigh the loss.

As has been previously stated it is an accepted fact that lorry transport is a necessity for a modern army and it has to be paid for. A State transport company stands a fair chance of financial success, and under the worst possible conditions would cost less than any subsidy scheme of practical value.

This proposal is not the outcome of casual observation of existing circumstances, but is made with an intimate knowledge of mechanical transport, both under commercial conditions, and under military control, not only in England, but also on the Continent ; and it is contended that a State transport company would not only spell economy, efficiency and an aid to commercial prosperity, but would in fact be the solution to the problem of military transport.

Digitized by Google

ECONOMY IN CONSTRUCTION: SOME SUGGESTIONS.

By LIEUT. E. ST. G. KIRKE, R.E.

ECONOMY nowadays is of such increasing importance that a few suggestions for effecting it may perhaps be of interest. In Delhi in particular, these notes may be of some use, since they are founded upon Punjab experience.

1. ROLLED STEEL BEAMS.

These form a large item of expense in building construction, particularly in those parts of India where the flat type of roof is retained, and it is seldom that the large saving which can be effected by the substitution of some form of truss is fully appreciated. The reasons for this may be any of the following :—(*a*). The requisite rolled steel beams are already in stock, or, owing to the necessity of spending money at the end of the financial year, time for calculating an alternative is too short. (*b*). Calculations for finding the requisite size of R.S. beam from the tables are so easy, and the beams themselves are so easily procured and handled that the designer does not feel called upon to enter into further investigation. (*c*). The building under consideration may be one in which a truss would be thought unsightly, *e.g.*, a residential bungalow.

The kind of truss suggested is on the same lines as that almost universally adopted for the sole-bars of bogie rolling stock for railways, with the substitution of I beams for channel beams. In roofs where a heavier section of R.S. beam than the 9 in. × 4 in. at 21 lbs. is required, the saving effected by the substitution of a truss may be in the region of 50 per cent. of the total R.S. beam bill. An example may be given. The standard type of Indian infantry barrack has a span of 20 ft., and for this the girder usually employed is a 10 in. × 5 in. at 30 lbs. The cost of these is something like Rs.45 each, but in some of the Pioneer Lines in Lahore a truss was introduced, formed of a 7 in. × 4 in. at 16 lbs. with a single central strut and tie-bar, which cost under Rs.30, and, had it not been for the fact that the 16-lb. beams were already at site, a further reduction could have been effected by the use of 12-lb. beams (6 in. × 3 in.). In the lines in question, which were not up to full establishment pending a decision

Digitized by Google

as to the proportion of married quarters, there were 15 girders in each of 16 blocks of barracks, or 240 in all. That is, a saving of at least £240 (Rs.3,600) could have been effected by putting in even the heavier type of truss. The objection may be raised that so light a girder would be insufficient, regarded as a strut, to sustain the compressive thrust along it. In practice however this excess over the theoretical safe working load is of no consequence whatever, inasmuch as the requisite lateral support can always be given by stout nails in the superincumbent rafters when tiled roofs are employed, and in the case of jack-arched roofs the arches themselves give continuous lateral support. In this connection it is interesting to record the fact that in Lahore Cantonment there is a flat tiled roof of 24-ft. span with 4 in. of mud superimposed, supported on 6 in. × 3 in. girders about 5 ft. apart, bent to an ellipse with a 1-ft. rise, the "bowstring" being a 1-in. rod. No lateral support had been given to them and they have consequently got a bit of a twist now, but they show conclusively what R.S. beams can be made to do without failure. For this span and type of roof theory would demand a 12 in. × 5 in. at 32 lbs., if only on grounds of deflection. The form of girder employed therefore represents a saving of something like 100 per cent. This brings us to the second heading under which great economy can be effected, namely :—

2. FACTORS OF SAFETY.

It is curious that the soundness of insisting upon a factor of safety of 4 has not been more frequently questioned, at any rate where static loads are concerned, especially in view of the excellence of modern rolled steel, and it is certain that a large measure of the favour accorded to rolled steel beams of continental manufacture in India is directly attributable to the greater loads which they are advertised to support, owing of course to a factor of safety of only three being employed in calculating their strengths. It is doubtful if such a beam fully loaded has ever failed in practice. Where the loads to be dealt with are partly permanent and partly occasional, the policy of allowing a factor of safety of 4 for the whole is obviously wasteful extravagance. A short time ago I met the engineer in charge of the Amir's roads in Afghanistan and asked him what factor of safety had been employed in calculating the strengths of road bridge girders. His answer was somewhat surprising: "1½, when they worried about one at all." Even so it appeared that no bridge had failed and they were only being strengthened to take motor lorry traffic, which the Amir is anxious to start between Kabul and Jellalabad. It is not suggested that a factor of safety of 1½ is sufficient or anywhere near it, but the story again shows what rolled steel beams will stand in defiance of theory. And we now come to the third heading :—

Digitized by Google

3. Moving Loads.

The railway engineer is confronted with a problem the solution of which, after more than 50 years' experience, still remains almost entirely empirical, and there are bridge designers in the first flight who hold that any allowance for impact on spans exceeding 40 ft. is entirely unnecessary. In support of this opinion it may be noted that deflection diagrams taken during tests of all manner of bridges over 40-ft. span fail to show any increase in deflection due to speed. Indeed it has frequently been noticed that the deflection at 60 miles per hour is less than at 30 miles per hour, and that both are less than when the test train is stationary on the middle of the bridge. This seems to be corroborated by all engineers of repute who have made a practical, as opposed to a theoretical, study of the question. The absence of increased deflection however is not proof that *individual* members of the bridge are not put to greater stress under a moving load such as is represented by a train, and Mr. Sales, Bridge Engineer to the N.W. Railway of India, has, after a long series of experiments, come to the conclusion that the weight on the driving axle of a locomotive may momentarily be almost doubled at high speeds. This is attributable to a variety of causes, such as the obliquity of the connecting rods, the balance weights of the driving wheels, wide rail joints, oscillation, or lurching due to uneven track, etc. Mr. Farr, in a paper entitled "Moving Loads on Railway Underbridges," read before the Institute of Mechanical Engineers in 1900, gave an impact curve varying from 30 per cent. increased stress for 5-ft. spans to 10 per cent. for 100-ft. spans for main girders, and for cross girders allowances varying from 50 per cent. for 3 ft., to 25 per cent. for 10-ft. spans. The reduction of this problem to a universally accepted rule, however, seems to remain as far off as ever, and it has been pointed out that the Britannia Bridge was stressed to something like 7 tons per square inch, without any allowance for impact whatever, 50 years after its erection. The Government of India rules allow a stress of 8 tons per square inch in mild steel, but their allowance for impact is something like three times as high as Mr. Farr's given above. While admittedly much too liberal for present requirements, this policy is held to be advisable in view of future developments in rolling stock, and the Government has already had ample experience of the inconvenience and financial loss arising from the necessity of strengthening or renewing girders on lines open to traffic.

The question of railway bridges has been touched upon as presenting the most difficult aspect of the problem of moving loads. The case before the military engineer who has to design a road bridge is an entirely different one. In his case the most disturbing factors in calculation (the moving and badly balanced parts of locomotives,

Digitized by Google

wide rail joints, etc.) are entirely absent, and in no form of road engine does the driving mechanism act direct on the road wheels. The question arises whether any allowance for impact whatever is necessary in designing bridges to take traction engines and other forms of military transport, unless indeed the intention is to run a light railway across it at some future date, as, for instance, the Gambila Bridge between Bannu and Dera Ismail Khan.

It is suggested therefore that a road bridge with a factor of safety of 4 and without any allowance for impact is amply strong enough, and that experiments with a factor of safety of 3 would not be wasted in the interests of economy.

4. WELL CURBS.

In alluvial soils, like that of the Punjab plains where sub-surface rock is entirely absent, the use of heavy and costly steel, or steel and iron well curbs seems to be quite unnecessary for ordinary water works purposes; possibly also for bridge work, though in this the writer has so far made no experiments. The substitute successfully employed in one of two additional 16-ft. diameter wells for the Lahore Cantonment water supply a year and a-half ago was ¾ per cent. reinforced concrete. The other well was sunk on a steel and wood curb identical with those of the four original wells. The subjoined comparison clearly shows the saving effected by the use of reinforced concrete, both in cost and time. The labour employed on the wooden curb could probably have got the reinforcement of the other ready in a couple of days. The concrete itself was mixed just on the edge of the well, in the proportion 1 : 1½ : 4, run down an iron shoot to site 18 ft. or 20 ft. below, placed and rammed in four hours. The other curb took 10 days to fix at site after a month's work above ground. Six oiled 1-in. wooden plugs were left in the concrete temporarily to make holes for the steining rods, as being easier to handle than the heavy rods themselves. The time taken to sink the two wells 28 ft. is also noteworthy. The one on the concrete curb, which had been made to project 2 in. outside the steining, was sunk in 36 days, the other in 52. I am indebted to Mr. Sullivan, M.W.S., for the following figures, and it will be noted that a large part of the cost of the reinforced concrete curb, namely Rs.147, is accounted for by the centreing, which is of course removable. The cost per well therefore in a large installation would be inversely proportional to the number of wells. Any old planks can be cut up and used for this purpose, and the bottom planks, which are responsible for most of the labour expended upon centreing, being sawn radially, might possibly be wholely replaced by the oiled paper which was used to prevent the cement running out through the chinks. The vertical planks are placed in position by striking radii from a central peg, and packing with bricks or earth behind.

Digitized by Google

Cost of Curbs including all Steel Work.

1. Wood and steel Rs.630

2. ¾ per cent. reinforced concrete 1 : 1½ : 4.

(*a*). Materials—

4½ barrels Portland cement at Rs.10/12	Rs.48/6/0	
3 cart loads sand at Rs.1	3	
70 c.f. ½-in. stone ballast at Rs.25	17/8	
4 cwt. mild steel ¼ in. and ⅜ in. round at Rs.12	48	
Planks, paper, oil for mould	113/2	
Total material	Rs.230	

(*b*). Labour—

(i.). Centreing—

4 carpenters for 7 days at Rs.1	Rs.28/0/0
2 coolies for 7 days at -/6/-	5/4

(ii.). Reinforcement—

2 blacksmiths for 5 days at Rs.1	10

(iii.). Mixing and placing concrete—

11 coolies for 1 day at -/6/-	4/2
1 bhisti for 1 day at -/7/-	7
1 mason for 1 day at Rs.1	1
1 mistri for 1 day at Rs.1/8	1/8
Total labour	Rs.50/5/0
Total	Rs.280/3

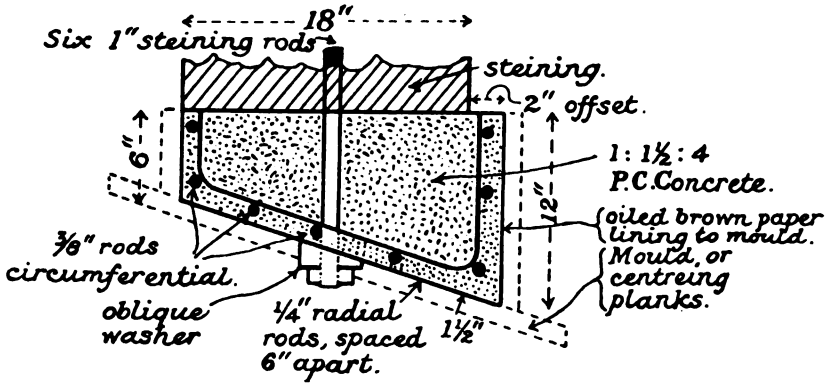
Mr. F. R. Bagley, late Engineer-in-Chief, N.W. Railway of India, has successfully sunk 16-ft. diameter wells on no more elaborate curbs than 2 ft. of corbelled cement masonry resting on a circumferential bottom ring of angle steel through which the steining rods passed, and there seems to be no reason why, for wells of moderate depth, this practice should not be more generally adopted, as it has all the necessary elements of strength.

As a result of the successful sinking of the Lahore Cantonment well on a reinforced concrete curb, it may be mentioned that the Lahore Municipality used the same material to sink all of 18 new

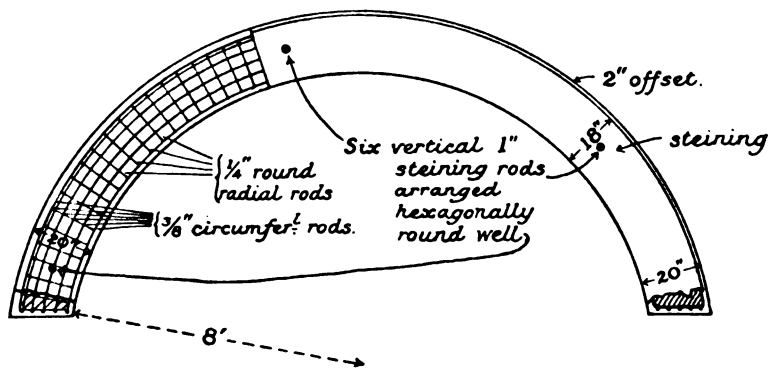
Digitized by Google

wells which were put down to meet an increasing demand for piped water a year ago.

Writing of reinforced P.C. concrete, the American plan of pouring it in of the same consistency as porridge, with no more ramming than is required to level the surface, will be found quite sufficient for all practical purposes, and saves a lot of unnecessary labour. A good way of avoiding leaks caused by cracked flanges in well suction pipes may here be mentioned, namely the introduction of a short length of flexible tubing between the steining and the suction pipe. Where wells are liable to settle after pipe connections have been made, this will be found to save a lot of subsequent trouble.



Section of Curb for 16-ft. Well.
Scale, 1 in. = 1 ft.



Part Plan of Curb.
Scale, 5 ft. = 1 in.

5. ROOF BATTENS.

The span between girders at which it becomes economical to replace single battens by rafters and light subsidiary battens for flat tiled roofs, is another question that seldom engages attention, and

Digitized by Google

the Table below has been made out, from the formula in the *M.W.S. Handbook*, on the assumptions that (for India) the depth of a rafter or batten should not exceed double its width, and that its width should not be less than 2 in. to efficiently support the tiles. It will be seen that it is cheaper to put rafters and small battens in spans of 7 ft. and over. An instance of the application of this Table may be cited. A saving of Rs.600 would have been effected in the roof of the upper story of a certain British infantry barracks for two companies, by the substitution of rafters and small battens for single heavy battens over 9 and 10-ft. spans. It will always be found cheapest to space the rafters 3 ft. apart, whatever their length, but this may not be always convenient.

Table of Battens and Rafters (Deodar) to Support Flat Double Tile Roofs with 4" Mud and Plaster.

Spans between Girders.	Rafters.	Battens.
3′	—	2″ × 1¾″
4′	—	2″ × 2½″
5′	—	2″ × 3″
6′	—	2″ × 3½″
7′	3″ × 5¾″ 3′ apart. 3¼″ × 6″ 3½′ ,,	2″ × 1¾″ 2″ × 2″
8′	3¼″ × 6½″ 3′ ,, 3½″ × 7″ 4′ ,,	Battens as per 3′—5′ above. ,, ,, ,,
9′	3½″ × 7″ 3′ ,, 4″ × 7½″ 4′ ,, 4¼″ × 8″ 5′ ,,	,, ,, ,, ,, ,, ,, ,, ,, ,,
10′	3¾″ × 7½″ 3′ ,, 4¼″ × 8″ 4′ ,, 4½″ × 8¾″ 5′ ,,	,, ,, ,, ,, ,, ,, ,, ,, ,,

6. Foundations.

In hard homogeneous soil, like the Punjab "pat," which is not subject to more than 10 degrees of frost, it will generally be sufficient for single-storied buildings to take the foundations only so deep as will bring them flush with ground level, especially when the ground round the building is banked up about a foot above its original level, for drainage purposes. The only danger to guard against is the

Digitized by Google

possibility of the ground in which the foundations rest becoming sodden in the rains, and in all ordinary cases the 1-ft. bank referred to above is sufficient. Where, as in the Punjab, surface soil is to all intents and purposes as hard as that deeper down, the practice of digging down 3 and 4 ft. for foundations is extremely wasteful, as the cavities thus excavated have to be filled in with masonry, and no good purpose is served. In the Ferozepore Fort the pressure on the foundations is over 2 tons per square foot in the case of the double-storied barracks, and this is shown to be quite a safe pressure for normal "pat" soil (though I believe only $1\frac{1}{2}$ tons is usually allowed). In the case of servants' quarters, provided a 1-ft. bank is put all round subsequently, there seems to be no reason for putting down any foundations at all, and just levelling up the ground under the walls will be sufficient. This statement may be objected to, but seeing that the mud walls and the ground are of exactly the same material it stands to reason that the undisturbed ground must be capable of standing a greater pressure than the built-up walls, and is therefore amply strong enough, provided it is in no danger from floods.

Digitized by Google

NOTES ON WIND PRESSURE ON ROOFS.

By LIEUT. C. R. SATTERTHWAITE, R.E.

THE question of the effect of wind on roofs is one which has never been very satisfactorily dealt with. Most of the text books at present in use tell us that wind on reaching a sloping roof surface may be considered as split up into two components, one normal and one parallel to the roof surface; the former only is considered in the design, as a downward pressure on the windward surface of the roof. If this were the true state of affairs we should expect to find the roofs of a cantonment after a typhoon blown in and downward into the buildings they covered: whereas it is a matter of experience that they are always blown upwards or outwards, and frequently found some distance from their buildings.

Many experiments to ascertain the true behaviour of wind on reaching a roof have been made in recent years, and all give similar results, namely, that downward pressure is caused on the windward, and upward suction on the leeward slope. Those carried out at the National Physical Laboratory at Teddington in 1908 by Dr. T. E. Stanton, who has very kindly given me permission to quote some of his results, are the most modern, satisfactory and comprehensive. They were carried out on large size roof models in the open air. R.E. officers frequently have to design large span roofs for exposed situations, and it is proposed in this paper to suggest some practical methods of calculation, based on the results of Dr. Stanton's experiments.

Attention will be confined to the design of roof principals, and those of steel only will be considered. Timber roofs for large spans are now unusual, and for small spans it is quite rightly the custom to disregard wind pressure as far as principals are concerned.

It has been customary to take 50 lbs. per foot super as the maximum wind pressure on a vertical surface in England. Dr. Stanton's experiments tend to show that this figure is excessive. His aim was to find values of the constant k in the formula $P = kV^2$, P being the pressure in lbs. per foot super due to wind of velocity V miles per hour. To do this readings of a pressure gauge were taken at the middle point of the principal rafter on both sides of roof models of

Digitized by Google

varying slopes, as well as on vertical surfaces. The means of supporting the roofs were varied, between the limits of an entirely closed building and an open shed without walls (such as a railway station platform). The results as far as they concern us may be stated as under.

TABLE I.—*Giving values of k in formula* $P = kV^2$.

For a vertical surface $k = \cdot0032$.

For a Roof on Stanchions without Walls.

Slope of roof	30°	45°	60°
Values of k { Windward side ...	+ ·0015	+ ·0028	+ ·0034
{ Leeward side ...	Negligible.		—

For a Roof of an Ordinary Building.

Slope of Roof	30°	45°	60°
Values of k { Windward side ...	+ ·0015	+ ·0028	+ ·0034
{ Leeward side ...	− ·0022	− ·0027	− ·0032

(Downward pressures are considered positive, upward suctions negative).

It remains to evolve a practical method of design based upon these data. It is suggested that 100 m.p.h. is the outside maximum wind velocity that need be legislated for in England ; indeed there are few stations abroad where it would be exceeded. As a round figure simplifies calculation 100 m.h.p. has been adopted as the maximum in the investigations following. The values of k in Table I. then become pressures in lbs. per foot super simply by removing the decimal point.

It must be noted however that they give the *intensity* of pressure at the middle point of the principal rafter. Now previous experiments* have tended to show that, on the windward slope, the intensity of pressure is greatest near the middle point, and decreases considerably towards the eaves and ridge ; indeed may become a suction at either of those points, depending on the angle of slope of the roof. As far as the design of the members of the principal goes, it will be found that little error is introduced by considering the pressure as distributed uniformly over the rafter, at an intensity equal to the average intensity over all ; that is, approximately half the maximum. This point will be further considered later. The suction on the leeward slope has been shown by the same experiments to be approximately of constant intensity.

* See *Min. Proc. Inst. C.E.*, Vol. CLVI., pp. 78, 105.

Digitized by Google

To illustrate the method suggested a simple roof of 40-ft. span is considered. The slope is 30°, the spacing of principals 10 ft. and the covering any one of the light modern materials such as ruberoid, asbestos slates, etc., on 1-in. deal boarding. The truss is of the common "king post" type and purlins are placed only over the joints on the principal rafter (*Fig.* 1).

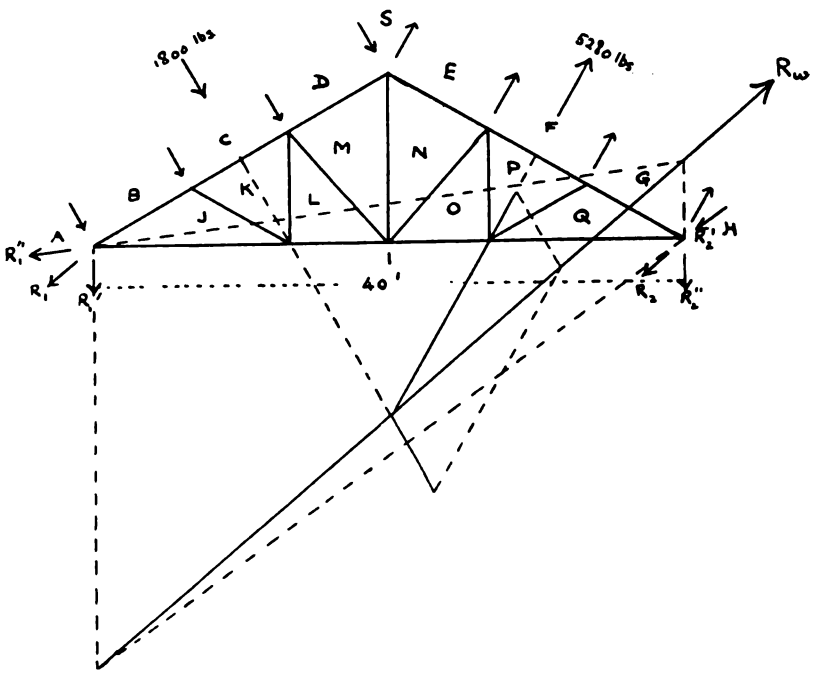


FIG 1.

The dead weight of such a roof, including the weight of the principals, will be about 10 lbs. per foot super, and by considering all this weight evenly divided up and applied at the purlins and pole-plates (the usual assumption) a fair estimate of the stresses in each member of the truss, due to permanent dead load, may be obtained by drawing a stress diagram in the usual way. These values are given in Column 2 of Table II. It is necessary further to allow for the weight of workmen on a roof, fixing or repairing the covering: taking this as equivalent to 20 lbs. per foot super dead load, and multiplying all the stresses in Column 2 by $\frac{20}{10}$ we get the values in Column 3 for the stresses due to occasional loads only.

It now remains to consider wind effect. From Table I. the intensity of normal pressure and suction at the centres of the principal rafters is 15 lbs. and 22 lbs. respectively: this gives a total pressure evenly distributed of $\frac{1}{2} \times 15 \times 24 \times 10$ or 1,800 lbs. per principal on the windward side, and a suction of $22 \times 24 \times 10$ or 5,280 lbs. per principal

Digitized by Google

on the leeward side. To estimate the wind effect only, we may consider the truss as weightless and in that case it is acted on by two sets of parallel external forces only, the resultants of which act at the middle points of the principal rafters. By combining these two (*Fig.* 1) the total wind resultant, R*w*, is obtained; and this is resisted by the reactions at the walls, which will normally be parallel to it. If the expansion end of the truss is slipping or about to slip, the reaction there must be vertical; and by considering each end of the truss "free" in turn and applying the triangle of forces we can assess all the external forces on the truss, for the three usual different cases. Stress diagrams can now be drawn for all three cases; they can be combined on one diagram, the reactions only varying. The wind loads—pressure and suction—may be considered as divided up among the joints on the principal rafter, and the diagram (*Fig.* 2) is comparatively simple.

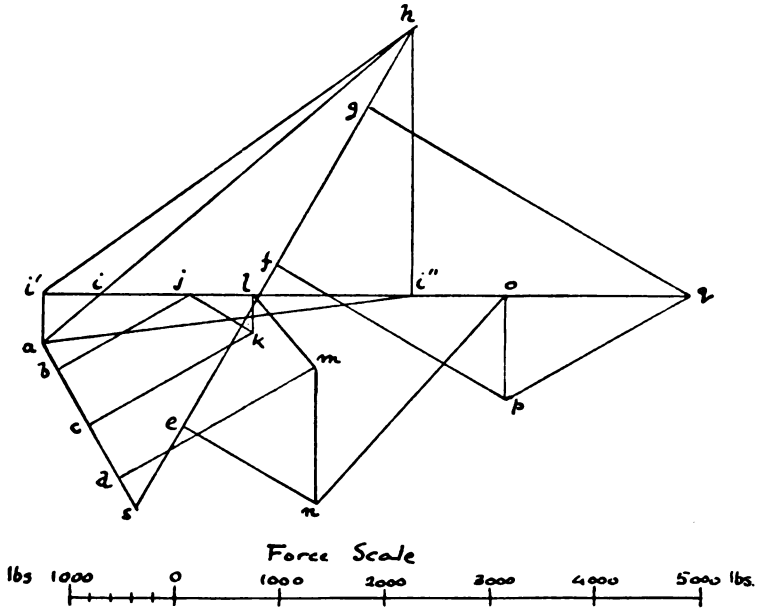


FIG. 2.

The stresses in the various members, given in Columns 4, 5, and 6 of Table II. are thus obtained. It will be seen that only the small stresses in the members on the windward side of the truss (JK, KL, LM, etc.) are effected by our assumption that the wind pressure is evenly distributed over that side. These stresses will not affect the ultimate design of the members, as they are less than those which would be brought on them by the workmen-load, or by wind in the opposite direction; so the assumption referred to seems justified, though it is true that the deviation from the centre of the windward

Digitized by Google

rafter of the "centre of effort" of the wind pressure on that side may cause slight inaccuracies in the determination of the "wind resultant," which cannot be satisfactorily legislated for. Columns 7 and 8 of Table II. now give the maximum stresses, + and −, to which each member may be subjected, under permanent load + either wind or workmen (but not both, as workmen may be trusted not to venture on the roof in a gale).

TABLE II.—*Stresses in lbs. on each Member of Truss.*

Member.	Dead Load.	Workmen.	Wind Pressure.			Maximum + Stress.	Maximum − Stress.
			Reactions Parallel.	Windward End Free.	Leeward End Free.		
BJ	+4000	+8000	−1440	—	−3600	+12000	
CK	+3200	+6400	−1800	—	−2520		
DM	+2400	+4800	−2160	—	−1440		
EN	+2400	+4800	−1440	—	−2160		
FP	+3200	+6400	−2520	—	−1800		
GQ	+4000	+8000	−3600	—	−1440		
IJ	−3460	−6920	+840	+1380	+2640	—	−10380
IL	−2770	−5540	+1440	+1980	+900	—	
IO	−2770	−5540	+3840	+4380	−1500	+1610	
IQ	−3460	−6920	+5580	+6120	−2160	+2600	
JK	+800	+1600	+720	—	−2040	+2400	−1240
LM	+1080	+2160	+960	—	−2700	+3240	−1620
NO	+1080	+2160	−2700	—	+960	+3240	−1620
PQ	+800	+1600	−2040	—	+720	+2400	−1240
KL	−400	−800	−360	—	+1020	+620	−1200
MN	−1600	−3200	+1320	—	+1320	—	−4800
OP	−400	−800	+1020	—	−360	+620	−1200

It seems that every member of the principal except the king-post is subject to compression under some conditions and many of them to reversal of stress. This would be the case with all members if the permanent roof load were lighter—corrugated sheets for example. All except the king-post then should be designed to take what compression they are liable to, and made of L or T-sections. The tie-bar is the only member largely affected; the use of a T-section for this is not inconvenient for the joints as a rule, nor does it involve a very large increase in the weight of metal in the truss.

Table III. gives the sections which might be adopted for the roof in question for the tie-bar and the short ties KL, OP, together with the sections which would be used if the roof were designed according to the old ideas; and the increase in weight involved. The other members of the roof will not be affected by wind pressure.

Digitized by Google

TABLE III.

	Section.	Weight per Foot-Run.
Tie-Bar—		
Designed as above ...	$3\frac{1}{2}'' \times 3\frac{1}{2}'' \times \frac{3}{8}''$ T	8·49 lbs.
Designed by old method ...	$3'' \times \frac{3}{8}''$ flat	3·8 lbs.
Short Ties KL, OP—		
Designed as above ...	$2'' \times 2'' \times \frac{3}{8}''$ L	4·62 lbs.
Designed by old method ...	$2'' \times \frac{3}{8}''$ flat	2·5 lbs.

The introduction of camber in the tie-bar would complicate the stress diagrams, but the general method remains the same and no great difficulties crop up.

Various practical points are impressed on the designer by these new ideas. The importance of securely fastening down the roof covering, to resist the leeward suction, is apparent. It also seems clear that the ends of the trusses themselves should be fastened down. If the wind resultant were to pass *below* the abutment (see *Fig.* 1) the reaction at the other abutment would be upward in tendency: this may occur in some cases.

It is recognized that the subject is by no means exhausted by the cases considered. The effect of wind on "saw-tooth" roofs, and the stiffening effect of hipped ends, are difficult questions, and further experiments are needed to throw light on them. It is hoped however that these notes may suggest methods suitable for simple cases, such as R.E. officers may encounter at any time.

Digitized by Google

MOTOR FIRE BRIGADE APPARATUS.

By Capt. E. H. Harvey, late R.E.

On former occasions when contributing articles on fire appliances to the *R.E. Journal* I have made reference to the continued progress in the adoption of the motor for fire work; during the last three years, however, the extension of the use of this class of apparatus has been so notable, that I hope a more complete summary of the subject up to the present date may be of some interest to Engineers who are concerned at times in matters of fire protection.

While from about ten years ago modern motor engines began to come into use by British fire brigades, it is only quite recently that some, at least, of our largest cities have definitely adopted the principle of a change from horse to motor traction. Now this change is in continued progress not only in London and our own great towns, but in Continental capitals such as Paris and Berlin, and in smaller cities abroad; so that before long it is reasonable to expect that in city work at least the horse-drawn engine will become a thing of the past.

Early Designs.

From quite an early period in the history of steam locomotion occasional efforts—most of them mechanically successful—were made towards the construction of motor fire engines. In 1840 Mr. Hodge at New York built a powerful machine having a locomotive boiler with circular fire-box of the "Bury" type—generally similar, in fact, to the 4-wheel railway locomotives of the time; the cylinders were horizontal and outside, and the piston rods prolonged through the front covers to work the two pump cylinders placed in front of the smoke-box with two air vessels between them. On arrival at a fire the hind wheels (the "drivers") were slightly raised from the ground by jacking up the after end of the machine, to allow them to revolve freely and act as fly-wheels while the engine was pumping. Four jets could be worked at once, and water thrown to a height of about 140 ft. This machine, efficient as it was, seems to have been in advance of its time, and no similar ones appear to have been built after it. In 1851 a steam self-propeller was built at Cincinnati, and in 1862 one in England, running on three wheels and with a vertical boiler, which attended fires in the east of London for a considerable time.

Digitized by Google

In 1877 Messrs. Shand & Mason fitted one of their "Equilibrium" engines also as a self-propeller, but do not appear to have considered the time yet ripe for repeating the experiment.

The restrictions placed on locomotives on the highway until recent years, naturally tended to discourage the construction of motor fire appliances as well as of all other motor cars; and so long as coal was the fuel in use for steam fire engines the difficulty arose that, it being impracticable to keep a coal fire always alight in a small boiler without choking the tubes, etc., the turn out would always be delayed by the interval necessary for starting a good solid fire in the boiler, sufficient to keep steam steadily on the road. Even then, these small boilers with their strong blast would cause a heavy smoke and emission of sparks dangerous and annoying to other traffic in our often narrow English roads. With the introduction of a paraffin spray burner, capable of being lighted up immediately at full power and causing little smoke, the motor steamer speedily became an accomplished fact; Messrs. Merryweather's motor "Fire King," brought out about the year 1900, being now so well known that it is unnecessary to give a long account of it. In this type of engine the same steam cylinders and shaft that work the pumps also propel the machine on the road; in a later type of motor steamer built by Messrs. Shand & Mason, there are separate steam engines for each purpose on the vehicle.

CLASSES OF MACHINES.

Motor and horse fire brigade appliances alike may be grouped in two principal divisions—(*a*). Those which are simply carriages for hose, life-saving ladders (from the large-wheeled telescopic escape to the "Pompier" ladder or the ordinary scaling-ladder), men, and tools, with the addition of a chemical engine for first aid in many cases, but which do not carry a full-powered pumping engine. (*b*). Engines in the strict sense of the word, *i.e.* large power-driven pumps capable of lifting their water by suction without necessarily requiring water-mains to supply them, and of working one or more powerful jets continuously through the full-sized hose. Class (*a*), where there is a good pressure on the street mains and a complete hydrant system, in large towns fulfil the purpose of an engine in many cases of everyday work.

MODERN ORGANIZATION.

In modern fire brigade systems the tendency is to organize the machines in what may be called "tactical units" for purposes of turn-out. That is to say such an unit will consist usually of a first-turn-out machine carrying a large fire escape, chemical engine, and hose, and of at least one engine, *i.e.* a steamer or motor pump.

Digitized by Google

The latter will often have a light telescopic ladder 30 to 35 ft. long carried on it, as an appliance for reaching windows over enclosed gardens and courts. Such an unit will therefore, with its two crews of firemen, provide for all ordinary contingencies. A long ladder will be added to the organization of the unit, with a third crew, in cases where the buildings of the district are generally large and high.

Motive Powers.

The foregoing division of the classes of machine has a certain bearing on the nature of the motive power which may be applied. Class (*a*) require no supply of power beyond that which takes them to their work; petrol is the most common in England, but electricity is also used in appliances for city work, particularly on the Continent, and will probably be much more so utilized as time goes on. Electric escape-vans have been put into service in London and Liverpool.

In class (*b*) the petrol motor is now being generally introduced, the engine being obviously so well adapted both for the propulsion and for the pumping. Four and six-cylinder engines of 40 to 70 H.P. are commonly employed. The "motor pump," if properly looked after by a qualified fireman-mechanic, is one of the simplest and most suitable forms of fire engine that can be devised. The self-propelled steam fire engine is also a most valuable and reliable appliance, but it involves (unless a few minutes delay be admissible, as may be the usual case where a country volunteer brigade has to muster) the cost due to its being always kept under a low head of steam.

Steam and Petrol Compared.

The question of "Steam *versus* Petrol" for pumping is one which does not yet appear to be finally settled. Some authorities yet prefer the steam engine, and the comparative working life of the two classes of engine is a matter on which long experience has yet to be gained. "Steamers" well looked after will last in service for 20 or 30 years, and even more (with a renewal of the boiler during that period): whether the modern petrol pump will show such a record remains yet to be seen. On the Continent and in New York (where the abolition of horse traction in the Fire Department is now in progress), steam fire engines are in use fitted on a motor chassis independent of the steam power, either petrol-motor or electric. In England some practical opinion inclines to the doubt as to whether a petrol vehicle is, in the interests of safety, peculiarly adapted to the carrying of a lighted boiler fire in such close proximity to the motor, more especially should the engine meet with an accident on the road. On the Continent the electric chassis for carrying the steamer appears to find favour, being both safe, and quiet running. Several points, however, appear worth consideration, which are these, in favour of the self-propelling steamer using its own steam. In large

Digitized by Google

towns, where the firemen are instantly ready for a turn-out, it is necessary in any case to keep the water in the fire engine boiler, by means of gas or hot water connections, at least on the boil to ensure steam being ready for pumping after a very short run ; being committed to this expense, and in the case of oil-fired engines (horsed as well as motor) to the need of keeping about 20 lbs. of steam always on the boiler in order to start the oil spray burner without the use of an air pump or lighting a fire of shavings and wood, it seems to be at least as simple a matter to utilize the steam already available—and which can be brought up to a pressure sufficient to propel the engine in a minute or two by turning on the spray burner full—as to incur the complication of having a second motive power fitted to the vehicle, with the need of both a "steam man" and an electrician, or motor-mechanic, to attend to the two parts of the gear. For reserve engines, which need not be kept always under steam, an electric chassis would probably be economical. Other points are that the steam self-propelled engine is independent of working within the limits of an electricity supply, and can therefore make a long country run if wanted. As a minor disadvantage it is less silent on the road than an electric vehicle ; but from a good deal of observation of these engines running at high speed, it would be hard to say that they are any more noisy than many a private motor.

Comparing the self-propelled steamer with the petrol motor pump as to running generally, the latter is faster on long open stretches of road, but in a crowded town either kind of engine can travel as fast as traffic conditions usually allow. Much, of course, depends, too, on the skill of the driver.

The steam motor needs two men to actually run it on the road, one steering and one attending to the boiler, as against one for a petrol machine ; but, on the other hand, it is practically advisable always to have at least two qualified men in charge of any such vehicle, in case of either meeting with accident while out on duty.

It may also be noted that in case of difficulty about oil supply for a steamer out on a country job, some modern oil spray burners are made easily removable, enabling the boiler to be stoked with coal if necessary.

FIRST TURN-OUT MACHINES.

Returning to the subject of first turn-out machines, the general modern tendency is to the adoption of (*a*) a large, or standard size, for principal fire stations, *i.e.* a vehicle carrying a wheeled escape, a chemical or first-aid appliance, space for about 1,000 ft. of canvas hose, and the small gear and tools necessary for firemen's work, including one or two hand chemical "extincteurs" of 7 or 8 gallons capacity, and probably a smoke helmet equipment, and (*b*) a rather lighter machine than the above, for sub-stations, with a telescopic extension ladder 35 or 40 ft. long, and similar accommodation

Digitized by Google

for hose, tools and chemical appliances. In each size of machines there will be room (standing or sitting) for at least 6 to 8 firemen, including the driver. One or two lengths of hook or "Pompier" ladder will also, probably, be part of the equipment. For signalling purposes on the road the ship's bell, now well known in London, and elsewhere, finds great favour; hung fairly high on the vehicle, and rung in the usual way, it has a remarkable carrying power, probably largely due to its position level with the heads of pedestrians and horses' backs. Very powerful gongs, rung by the driver's foot acting on a "push" in the footboard, are also much used, and do not require a second person to work them, as the bell does.

In regard to the chemical engine the adoption of motor propulsion, petrol or electric, for first-turn-out machines has rendered it possible, where desired, to dispense with the necessity, hitherto existent in horse-drawn vehicles of this class, of the chemical action, or of a compressed air or CO_2 bottle to provide the motive power for a first-aid jet through small hose. What is more important is that the necessity of a closed chemical cylinder or tank to carry a high pressure—with the need of careful inspection, and the possibility (if not kept in good order) of serious explosion—passes away through the substitution for the chemical (or other pressure) arrangement of a small pump driven either by friction gear from the propelling motor, or electrically from the accumulators that drive the vehicle to and from its work, and of an ordinary tank of water. This principle was also previously adopted in some of the steam Merryweather "Fire Kings," which were fitted with an auxiliary pump and a tank for the first-aid water supply, about 30—40 gallons. It would be, moreover, a much easier matter to replenish the supply tank by means of a line of hose (or even bucket supply), and so enable the first-aid jet to complete its work without setting an additional delivery to work from a large engine or a hydrant. On the Continent a fitting has been adopted in some cases with a similar object in view, *i.e.* the continuance, where thought desirable, of the small first-aid jet until the fire is completely extinguished. This is the inclusion in the line of delivery hose from the first-aid (or chemical) engine of a three-way piece with controlling valves. To the second inlet of this, when run. out, connection is made by suitable fittings to a hydrant while the chemical engine is discharging itself in the first attack; and should the supply in the latter be not quite sufficient, the hydrant is turned in to continue it, the chemical cylinder, when empty, being shut off.

In regard to the method of carrying first-aid hose, modern English practice favours a hydraulic reel, fore-and-aft on the vehicle (situated below the escape ladder when stowed for travelling). From this the hose can be run out equally well, and walked away with immediately to either side into a burning building; and the

Digitized by Google

water (as in a garden reel) passes through the whole length of the hose coiled and extended, so that no delay arises in starting the jet, which is delivered through a ¼-in. nozzle.

The length of the first-aid hose is about 140 to 180 ft.

MOTOR PUMPS.

Passing on to the subject of petrol engines, *i.e.* motor pumps, two classes are in use, varying in the nature of the pump. This may be either of the reciprocating or the high-pressure turbine type, and two representative makes of engine may be briefly mentioned as in use by the London Fire Brigade, and in many other towns, *i.e.* the Merryweather "Hatfield" with Aster motor, and the Dennis motor carrying the Gwynne turbine pump. Very high pressures of water (over 200 lbs. per square inch), indispensable to firemen in these days of high buildings (*e.g.* in cases such as the Carlton Hotel fire in London), are easily attained by either class of pump. The motors have either four or six cylinders, as previously stated. In these two types of pump, for the turbine are claimed the advantages of simplicity, saving of space by the absence of air vessels, and the capacity of delivering a very large quantity of water at a low pressure when required for such work as cooling down ruins. On the other hand special means have to be fitted to exhaust the suction when first getting to work with a lift from open water, as from the edge of a wharf or sunk cistern. In many towns where the suction hose is connected direct with the hydrant, this additional fitting will only occasionally be brought into use, the water, of course, entering the pump at once with the pressure in the main, and no vacuum having to be artificially obtained to start.

The nominal delivery in gallons per minute is, in petrol fire pumps, similar to that of the standard steamers in use, *i.e.* 350, 400, and 500—discharging through two or more hose outlets, according to size. The pump is fixed across the machine at the rear end, and driven by a shaft along the centre line from the motor. The exhaust passes away by the usual outlet as when travelling. The ordinary fittings for carrying hose and tools, and seats for several men are provided, as in the motor escape-vans, sometimes an extra large size hose box, and often a light ladder overhead. A glass motor wind screen is added to some machines of recent make. The weight loaded and manned will be from 4 to 5½ tons.

POINTS IN WORKING.

In considering various types of petrol motor engines the following points are suggested as being worthy of special observation where comparison is desired :—

(*a*). Horse-power and number of cylinders in relation to delivery of pump per minute.

Digitized by Google

(*b*). Comparative amount of vibration and number of revolutions when working at full power.

(*c*). Delivery of water through at least 150 or 200 ft. of canvas hose on each delivery outlet, with working-size nozzles on each. A motor pump or steamer will generally stand at some little distance from a burning building when at work, for the sake of safety and convenience—perhaps 100 yards away or more, even in a town; tests through only a very short length of hose are, therefore, hardly a measure of practical working conditions. The pressure maintained to be, of course, noted. A moderate quantity of water at a very high pressure is more useful to firemen in city work than a larger quantity at low pressure, owing to the height of modern buildings, at the top of which, very often, the branches will be at work.

(*d*). The ease and rapidity with which the pump picks up its water from a fair lift: it is suggested that during a test the pump be stopped at short notice and re-started, the time of again delivering the jets being noted. Engines have to stop work in this manner in practice and re-start as soon as possible, owing to the need of shifting hose, or replacing, perhaps, a damaged length at a critical time in the operations.

(*e*). The manner in which the machine travels on the road, with regard to the steadiness and easy riding of any long ladders carried overhead.

Use of Tractors.

A concluding note on the matter of engines may be made on the subject of the employment of motor appliances as tractors for the hauling of reserve machines to the scene of a large fire in lieu of horses. Many fire brigades possess serviceable horse-drawn steamers which it would be a loss to sell or to scrap, even though they may be superseded for ordinary calls by modern motors. A powerful first-turn-out machine might well be adapted in such cases with a draw-bar arrangement for the bringing up of these older engines, as it would, after unloading its complement of men, hose, etc., otherwise at a great fire have no particular duty. Such an arrangement (*i.e.* for the haulage of a large steamer by petrol motor engine) has been successfully brought into use recently in Dublin. It would be of course necessary to provide ample brake-power, and ascertain that the roads are suitable for the handling of a tractor.

Motor Long Ladders.

Of motor appliances which yet remain to be noticed are the varieties of self-propelled long ladder, a 4-wheeled motor van of great stability on which is carried a self-supporting escape of extreme strength and stiffness, revolving, when erect, on the vehicle on a turn-table arrangement, and reaching a height of 70 to 90 ft.

Digitized by Google

From the top of such a ladder, standing balanced with its own counterweights away from a burning building, a fireman can effectually direct a jet of water at a safe distance; and these appliances are increasingly finding favour for use at warehouse and similar great fires in London and other British cities at home and abroad.

A long ladder, while not so much intended primarily for life-saving, is always valuable for that purpose in difficult situations, as it may be pitched at a low angle, and bridge over enclosed courtyards, etc., to the top of a high building far back from the street to which otherwise a 40 or 50-ft. escape could not always gain access. Moreover, in some such cases where the ground floor is well alight, it may be difficult even to raise a chain of "Pompier" ladders, and the long ladder (covered by jets of water, if necessary, for a short time) would carry the rescuers well above the worst of the heat during their difficult task.

In concluding this article, mention may be made of the reduction in time of turn out which is effected, with proper maintenance in the stations of a professional or a permanent police brigade, even as compared with the standard attained by the best quick-harnessing arrangements for horses. Records of as low as 8 to 10 seconds have been attained with petrol-driven appliances, and generally speaking the start of the machine is facilitated by the use of the motor, especially in stations where the engine room is cramped for space.

A useful invention for raising steam from cold water in the case of self-propelled steamers which stand (as in some country brigades) with a cold boiler, has also been recently brought out, in the form of a portable oil-flare apparatus worked by a hand blower, similarly to the heating of the vaporizer of a stationary oil engine. The flame of this—played into the firebox door of a "Fire King" engine—enables steam to be very quickly raised to the pressure necessary for the operation of the ordinary spray burner by the boiler itself, and obviates the necessity of lighting a wood fire in the firebox.

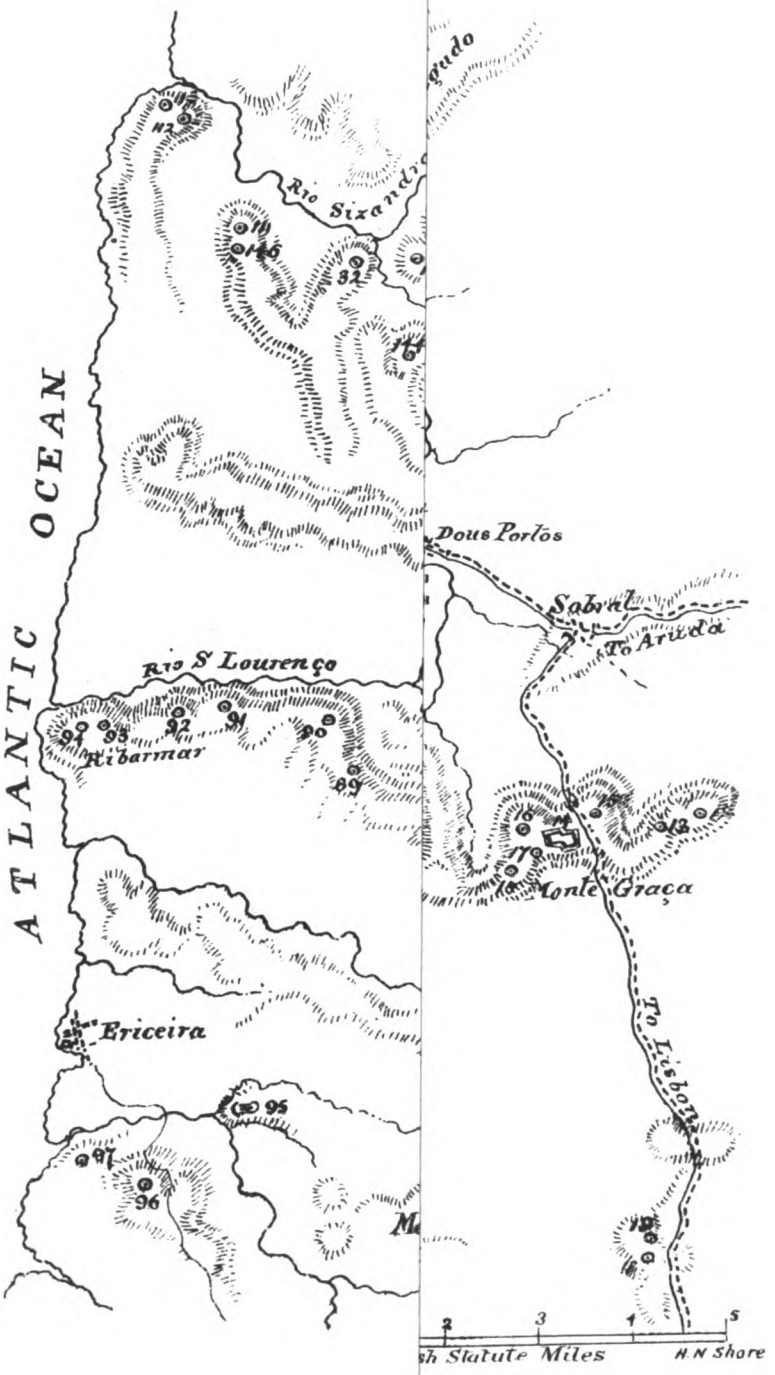
Digitized by Google

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

Map of the western portion oubts were numbered, in the first instance, consecutively regard to date, in which the works were constructed. *in Spain*, and from the Portuguese Government map.



Digitized by Google

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(*Continued*).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

To resume the Diary :—

August 12, 1810. The Telegraph at the Castle completed. Ross of the Artillery rode to Linhares, from whence he distinguished the signals made by the Portuguese Telegraph with one arm, fixed upon the Castle here (Celorico). The French are reported to have retired from Penamacor towards Coria ; the peasantry have harassed them considerably during their stay in that neighbourhood.

August 13. The Portuguese General Silveyra has taken a Battln. of the 3rd Swiss Regt. in the French service, in Puebla de Canabria, consisting of 400 men ; they had been shut up in that place from the 29th of July, previous to their surrender.

August 15. The Telegraph at Guarda reports a skirmish to have taken place in front of the city, in which Capt. Cocks, 16th Lt. Dragoons, aided by the peasantry of the country had killed 4 and taken 18 of a party of the enemy. Enemy said to be moving on our left.

August 18. The army begins to get into motion towards the front, and reports of an immediate advance become prevalent. Mulcaster writes me from Guarda ;—" 17 *August*, 1810, 8 p.m. The firing has been very brisk from Almeida during this day. The enemy are certainly constructing a Battery on the Knoll opposite the face of the exposed Bastion. They are also at work near the Mill, and appear to occupy a house between that and the Knoll, nearer the ruins." At this time, Maj.-Genl. Picton's Division occupied the town of Celorico and neighbourhood ;—the Guards, Cortica and vicinity ;—the Light Division at Riturina, 3 or 4 miles in front and to the right.

August 20. The Guards arrive and are quartered here (Celorico). Genl. Picton's Division advance to the village to the left of Marsal de Chao ; the Light Division move to Freixerao ; the Cavalry are encamped in the valley between it and Alverca ; Head Quarters are to move to Alverca ; the Guards were ordered to march there also ; but in the course of the day they were countermanded, and all idea of a forward movement vanishes.

Digitized by Google

August 21. Head Qrs. returned to this village (Alverca da Beira). After dinner Col. Fletcher and I rode to Freixedas, and from thence with the Marquis of Tweedale to a hill from whence we had a tolerable view of Almeida; the sun set just as we reached the hill and prevented our seeing the enemy's works. Almeida keeps up a constant fire upon the besiegers. Mulcaster writes from Guarda, Aug. 19, that the enemy have completed a parallel from the Mill to the Knoll, and have begun a zig-zag from about the centre of it. The firing continues from the place. The Col. and Chapman looking out for Telegraph situations.

August 25. The Guards move from Celorico to Marsal de Chao. A party of 13th Lt. Dragoons and Portuguese Cavalry take 2 officers and 39 Dragoons near Belmonte, the Comdg. Officer and 2 others only escaping.

This dashing little affair, in which the hitherto-despised Portuguese cavalry gave a specimen of their mettle, is less known than it deserves to be. Capt. Warre, on the staff of Marshal Beresford, wrote to a friend, under date, Aug. 29,—"Capt. White of 13th Light Dragoons speaks very highly of the gallantry and good conduct of Cornet Raymundo Oliveira and the troop of the 4th Cavalry who charged along with his own troop, and tumbled the mounseers over in a minute (near Castello Branco). They attacked 60 French Cavalry, and without loss of man or horse, took 50 men, 7 corporals, 3 sergeants, 2 officers; others were killed by the peasantry; not one went back to tell the tale."

August 26. Very heavy firing at Almeida during last night; increased in the morning and during the day; the enemy said to have begun their 2nd Parallel, and to have opened their Batteries on the place.

August 27. An explosion heard in the direction of Almeida last night. The firing ceased about 10 o'clock this morning. Col. Fletcher and I went to the hill on the left of Freixidas at sunset; found everything perfectly quiet in the neighbourhood of Almeida, and concluded that the Fortress had surrendered. Upon our return to Alverca found that Lord Wellington, having come to the same conclusion, had given orders for the army to retire at daylight. At ½ past 9 o'clock a heavy fire recommenced at Almeida and continued until midnight, in consequence of which the orders for retiring were suspended. A violent thunder storm with rain again at dusk.

August 28. Lord Wellington, Col. Fletcher, etc., rode to the front at daylight; no firing heard from Almeida; the enemy felt about our videttes with a few cavalry and infantry. About 10 or 11 o'clock orders were given for Head Qrs. to move to Celorico. The Lt. Div., and Genl. Picton's, halt in the vicinity of Baracal and Marcial de Chao; the Guards in Celorico; the cavalry at Alverca. The enemy entered Freixidas, murdered 3 old men, destroyed the Telegraph,

Digitized by Google

and soon after retired. A great deal of thunder and lightning all day.

August 29. A French Colonel and 3 men of Massena's *gens d'armes* brought in by the peasants from a village between Fort Conception and Guarda. Went with the Col. to Marsul de Chao and fixed upon the height above the village for the Telegraph to communicate from Alverca to Celorico. I rode on to Alverca and examined the hill to find the most eligible site for a Telegraph. A peasant who escaped from Almeida yesterday afternoon came in and reports that the town did not surrender until Tuesday (Aug. 28) about 10 o'clock; that the garrison laid down their arms on the Glacis, and were marched as prisoners towards Ciudad Rodrigo; and that the Magazine in the Castle had blown up and damaged the town considerably. The Lt. Div. move into Celorico and the villages near the bridges; the Guards and the remainder towards the rear.

The disaster, which had so unexpectedly befallen Almeida, is thus described by Napier :—"This fortress was garrisoned by 4,000 Portuguese regulars and militia under the English Col. Cox. On the morning of Aug. 26th sixty-five pieces of artillery, opening at once, set many houses in flames, which the garrison were unable to extinguish. The counter-fire was however briskly maintained and very little military damage was sustained. Towards evening the cannonade slackened, but just after dark the ground suddenly trembled, the castle bursting into a thousand pieces gave vent to a column of smoke and fire, and with a prodigious noise the whole town sunk into a shapeless ruin! Treason or accident had caused the magazines to explode, and the devastation was incredible. Further resistance was impossible."

The Governor, Colonel Cox, hoped to have held out notwithstanding, till the allies could succour him; but his efforts were foiled by treachery, and the expressed determination of the Lieut.-Govr. to hoist the white flag. Accordingly the place capitulated.

The only Portuguese Regt. of regulars amongst the garrison of Almeida was the 24th; and very conflicting statements have been published as to their conduct after capitulation. Napier says bluntly, "The 24th Portuguese regiment certainly took service with the French in a body. Yet, so easily are men's minds moved by present circumstances, that the greater number deserted again when they saw the allied armies." Lord Londonderry speaks of this in even stronger terms, but how little deserved was his sweeping condemnation will be evident from a consideration of the facts set forth by Southey. He tells us that, "when the Portuguese laid down their arms, they were invited to volunteer into the French service; but not a man was found base enough to come forward. On the following day, they were tried separately; and were told, that unless they accepted the

Digitized by Google

alternative that was offered them, they must immediately be marched into France; and the hardships they would suffer were represented to them in strong terms. Officers and men, with an unanimity which might well have been suspected, agreed then to enlist in the enemy's service. They found means of informing Marshal Beresford that they did this only for the sake of remaining within reach of their own country, and making their escape as soon as possible; and the truth of this was proved by the numbers who soon rejoined the allied army."

Marshal Beresford immediately issued a general order expressing his strong disapprobation of such conduct; for the soldiers, he said, some allowance was to be made; yet he hoped that in future any who fell into the enemy's hands would suffer anything rather than bring a stain upon the national honour. With regard to the officers, however, he declared nothing could excuse conduct so base, so abominable, and so unworthy of the Portuguese name; they had rendered themselves false and infamous; and that he should report their conduct to their Prince, that they might be dismissed with ignominy from the service. He at the same time published the names of five officers who, under a proper sense of duty, had refused to dishonour themselves in this manner.

Southey further states that a night had not elapsed before great part both of officers and men were missing, and in less than a fortnight nearly the whole had escaped;—"the men, instead of deserting, rejoining their countrymen in arms; the officers, unconscious of having done anything unworthy, presenting themselves to the commander of the first detachment they could reach, in a condition which pleaded for them, exhausted with fatigue and hunger." Further enquiry led Marshal Beresford to mitigate the terms of his censure, and to refer the conduct of these officers to a council of inquiry. Further light confirmatory of the above, is thrown on the matter by our Diarist.

August 30. Got the Telegraph erected at Alverca, at daylight this morning; it fell down soon after; but, thro. the assistance of Capt. Bull of the Horse Artly. repaired and replaced it again.

Celorico, August 31. Head Qrs. remain in this town ready to retire upon the advance of the French which is hourly expected. The men belonging to the Militia Regts. at Almeida (the Guarda and Arganil) came in, having billets signed by the Marquis de Alorna (a traitorous Portuguese officer who had taken service with the French on Junot's invasion, and was now on the staff of Marshal Massena) stating that they are to return to their homes and not to take arms again; they report that some, if not the whole of the regular Regt. there, No. 24, (reported as in "very good order" by Capt. Burgoyne in his Diary) have entered the French service. The governor (Col. Cox) and English were marched as prisoners into Spain.

Digitized by Google

Sept. 1. The enemy's advanced pickets along our whole front appear to be withdrawn towards their own lines.

Sept. 2. A party of the enemy drove in our Cavalry Piquets from Freixidas and Alverca. Head Qrs. remain in readiness to retire at the shortest notice; orders given to march to Cia in the morning.

Sept. 3. The French retire from Alverca and Freixidas again. Head Qrs. removed to Gouveia, beautifully situated on a small river, and on the side of a hill at the foot of the Serra de Estrella.

Head Qrs. remained here from the 3rd till 16th Sept. Napier thus explains the inactivity of the enemy :—" Massena, chilled by age and honours, was wasting time. He found it difficult to feed his troops, was disinclined to invade so late in the year, and undecided as to the mode. It was two months since Ciudad Rodrigo fell, Almeida had only resisted ten days, yet the French Army was still behind the Coa. It was not until the 15th that Massena's intentions declared themselves : and he advanced in entire ignorance of the tremendous impediment that had been thrown across his path to Lisbon—his declared goal, and the prize he already considered within his grasp."

The entries in the Diary, during this period, may be thus epitomized :—*Sept. 5th.* Ross gone to Celorico to establish a Telegraphic communication with this place. *7th.* Two deserters report that the army under Massena began to retire towards Salamanca and Valladodid 6 days ago; rumours prevalent that the French are making a movement on our right. *10th.* The peasants brought in a French Surgeon as prisoner; he is a most shabby figure, and states that Marshal Massena's Head Qrs. are to be at Pinhel to-morrow. *The 24th Regt. of Portuguese infantry who were taken at Almeida, and who entered into the French service have (with the exception of about 20) all deserted and rejoined us.* (The italics are the Editor's). *12th.* Received Newspapers from England to the 25th July; filled with erroneous and ridiculous statements in the shape of private letters from the army. *13th.* Goldfinch went to the top of the Serra last night at 11 o'clock, with W. and B. to see the rising of the sun from thence. *14th.* Papers arrived from England; received a letter from poor Hamilton's mother (Capt. Hamilton, his brother-officer who died at Lisbon).

Sept. 15. Heard this evening that the enemy had advanced in force to Celorico. *16th.* Head Qrs. removed to Cea, about noon. The Divisions of the army begin all to retire. Goldfinch remained at Gouveia with Lt.-Col. Waters* to ascertain what numbers of the enemy pass.

Filiadoza, Sept. 17. Marched from Cea to this place in the afternoon; the army continues retiring. Col. Fletcher and Chapman set off in the morning to reconnoitre about Ponte de Murcella. Had a

* A very active and enterprising " Intelligence Officer."

Digitized by Google

severe attack of the ague before I quitted Cea; obliged to lie down immediately upon my arrival here. Heard that part of the enemy's force had crossed the Mondego.

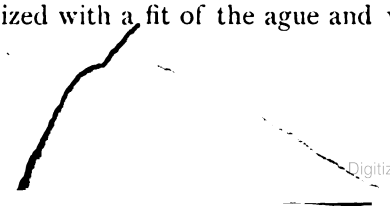
Cortica, Sept. 18. Quitted Filiadoza at daybreak, and proceeded along the main road towards Ponte de Murcella, through Lerosa,—like every place in this part of the country, entirely deserted, the poor peasants flying with what they can carry off in every direction.

Lord Wellington, unable, from the smallness of his force, to stem the flood of invasion, was now retiring upon that "stupendous and impregnable citadel," in front of Lisbon, which his forethought had caused to be raised; while the more effectually to thwart the enemy's designs, he had induced the Portuguese authorities to order the inhabitants along the line of invasion to destroy their mills, remove their boats, break down their bridges, lay waste their fields, abandon their dwellings, and carry away their property. "It was a design of terrible energy"—as Napier truly observes; that it was not literally carried out, need cause no surprise; for—as Napier does well to remind us,—"Wellington was a foreigner, ill-supported by his own Government, and holding power under that of Portugal by a precarious tenure; and he was vehemently opposed by the local authorities, by the ministers, and by the nobility." Moreover, Massena, on the eve of his invasion, had issued a proclamation to the Portuguese, in which he informed them that the Emperor of the French bore them no enmity;—"on the contrary, it is his highest wish to promote your happiness, and the first step for securing it is to dismiss from the country those locusts who consume your property, blast your harvests, and palsy your efforts"; and he went on to assure them that "in opposing the Emperor, you oppose your true friend; a friend who has it in his power to render you the happiest people in the world." But the conduct of the French troops in the course of two previous invasions proved the worthlessness of the Emperor's professions of friendship, and had excited against them feelings of utter detestation.

Reverting to the Diary:—

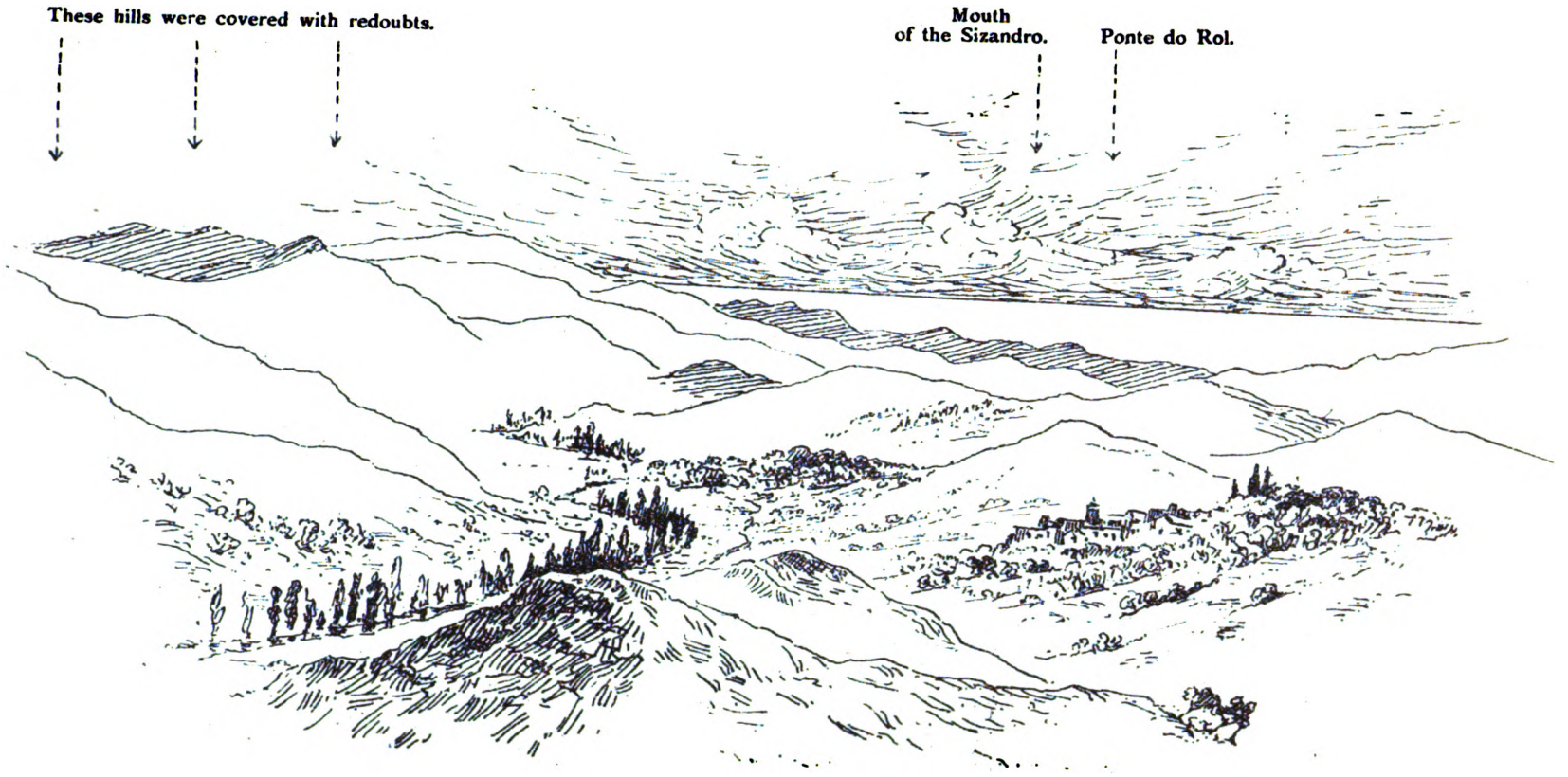
Sept. 19. *Cortica.* The army began to move towards and across the Mondego, it being ascertained that the main body of the enemy are in Viseu and its neighbourhood. Capt. Mulcaster ordered to proceed with B.-Genl. Pack's Brigade to destroy the bridge near San Combadao and to prepare that at Criz. Lt. Thomson went to destroy the bridge at Taboa. Capt. Burgoyne ordered to Coimbra to report upon the bridge there and wait for orders respecting it. Capt. Chapman reconnoitred part of the position near Moita. The Col. accompanied Lord Wellington on a reconnaissance the other side of the Mondego.

Sept. 20. Passed thro. Ponte de Murcella to Val de Mayor where I was seized with a fit of the ague and was obliged to lie down in a



Digitized by Google

Looking west from the Great Redoubt, Torres Vedras, showing the course of the River Sizandro, which was dammed at intervals, so as to flood the valley, and the distant ocean.



Digitized by Google

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Digitized by Google

cottage 2 or 3 hours before I could proceed. We crossed the Mondego at the ford below Pena Cova; with much difficulty I arrived at Lurvao. Quartered in a tolerable house with civil people and procured good beds.

Sept. 21st, 22nd, 23rd, 25th. Marched from Lurvao to the Convent of Bussaco. Head Qrs. occupied the whole of the Convent*; the Departs. attached to Hd. Qrs. are in the little Chapels which are scattered about the grounds round the Convent. We are in that of Calvary on the hill overlooking the country north of Coimbra. Took my Qrs. in the adjacent little cell of the Hermitage of the Sepulchre, where I remained for the most part within doors during the five days mentioned on the margin; being so ill and weak from the ague that I was unable to go out; our officers were busily employed in forming communications along the position in the Serra, and making a Flèche for musketry on the left. On the afternoon of the 25th, the enemy advanced upon Mortagao and drove our advance into the position, taking up their own ground on the opposite hill. Hoey of the Adjt.-Genl.'s Depart. severely wounded whilst looking out in the front.

NOTE.—In respect of scenic effect, and grandeur of its surroundings, probably no military spectacle was ever more superbly staged than that witnessed by the allied troops, from "grim Busaco's iron ridge" on the afternoon of Sept. 25th, 1810, while the French Army was taking up its position on the ground facing, but rather below, that occupied by the allies. "My regiment had no sooner piled arms," wrote Capt. Sherer, "than I walked to the verge of the mountain on which we lay, in the hope that I might discover something of the enemy. Little, however, was I prepared for the magnificent scene which burst on my astonished sight. Far as the eye could reach, the glittering of steel, and clouds of dust raised by cavalry and artillery, proclaimed the march of a countless army; thousands of them were already halted in their bivouacs, and column after column, arriving in quick succession, reposed upon the ground allotted to them, and swelled the black and enormous masses. Here lay before me the men who had once, for nearly two years, kept the whole coast of England in alarm; who had conquered Italy, overrun Austria, shouted victory on the plains of Austerlitz, and humbled, in one day, the power, the pride, and the martial renown of Prussia, on the field of Jena." To this inspiring description there is appended, in a pencil note, by an unknown reader:—"Scarcely a dust, as the movements were executed either on grass or on heath. I remember it as if I had

* As late as the year 1844, the Prior, leading an English visitor into a long hall, from whence many cells opened, said to him, "Here, before the battle your great Duke established his quarters; in that room he slept; see, I have painted the name of 'Wellington' over the door."

(Now converted into a sumptuous Hotel, and advertised as one of the "Beauty-spots" of Portugal. At the time in question, the vast enclosure was a *terra incognita*).

Digitized by Google

seen it but yesterday—the vast square bodies of infantry supposed to contain nearly twenty-thousand men each ;—when they took their ground it seemed as if they would have kept ranging for ever. . . . Numbers of fires—the fires of the two armies, making the night one of the grandest sights I ever saw,—and was, during the whole time they were opposed to each other." Even Napier admits that, "only veterans tired of war could have slept while that serene sky glittered above, and the dark mountains were crowned with the innumerable bivouac fires of more than a hundred thousand warriors."

Reverting to the Diary :—

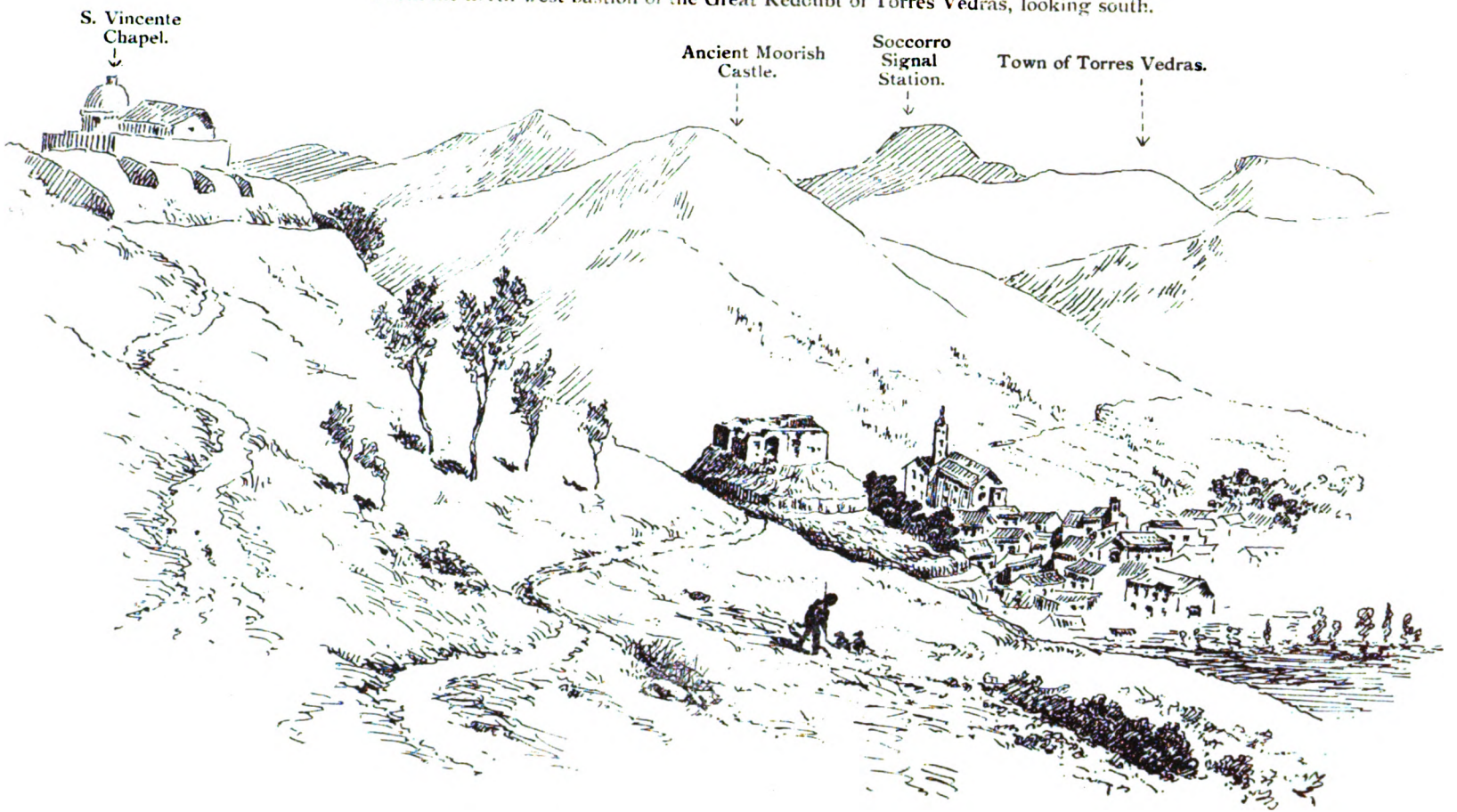
Sept. 26. The whole line under arms before daylight this morning. The fog was for some time very thick ; when it cleared we perceived the enemy upon the opposite hills ; but they did not attack us during the day ; remained on the ground until dark.

Sept. 27. The enemy attacked our position soon after 6 o'clock this Morning, in two strong columns. One attempted to push up the road to the Convent, but were repulsed as they reached the brow of the hill, principally by the Light Division. The other at first succeeded in gaining the summit near where the road from St. Antonio de Cantara to Coimbra crosses the mountain, but were soon driven back. General St. Simon and 300 men taken ; about 2,000 left on the ground, and from 5 to 6,000 wounded is the loss of the French. We lost not more than 200 killed and 1,000 wounded. *The Portuguese astonished us by their coolness and bravery, more particularly their Cacadores.* (*Light troops*). (The italics are the Editor's).

The Battle of Bussaco is wont to be regarded as a British victory. It must come as an unpleasant surprise, therefore, to many people to learn that but half of Wellington's army, on that memorable occasion, was composed of British troops. In the first place there was a contingent of Germans—chiefly Hanoverians—known as the "King's German Legion," a body of soldiers who rendered invaluable service throughout the war. But the battle was chiefly notable for the participation therein of Marshal Beresford's newly-organized Portuguese army, of which over 20,000 men were lined up with the British troops, for the first time, to give battle to the French invaders. That is a feature of the battle our writers are too prone to ignore. It is well to bear in mind, moreover that in default of those brave soldiers Wellington would never have offered battle. All hope of effective assistance from the Spaniards had long been abandoned. The number of British troops available was insignificant. The Portuguese were the last hope ; everything hinged therefore on their conduct. Would they face the French ? The opponents of the war, in England, had scouted the notion of Portuguese levies facing the veterans of Austerlitz ; and it must be frankly confessed that, amongst the generality of British officers at the seat of war, there was a feeling of utter scepticism concerning the fighting qualities of the Portuguese—

Digitized by Google

From the north-west bastion of the Great Redoubt of Torres Vedras, looking south.



Digitized by Google

Digitized by Google

a view differing but little, indeed, from that expressed by Massena in a letter to the Emperor, before the battle—that they were "a *canaile* who would bolt at the first shot." The hour had arrived when the mettle of the Portuguese troops was to be put to the test. And, naturally, profound anxiety was felt as to the issue. If they turned their backs on the invader, all hopes of saving Portugal must be abandoned, and the British troops withdrawn from the country. So completely had the English Government given up all hope of success, that, at this very time an officer of Engineers had arrived at Lisbon, whose instructions,—received personally from Lord Liverpool, commenced thus :—"As it is probable the army will embark in September."* The transports were lying in the Tagus.

In the battle, the Portuguese bore themselves nobly ; winning ungrudging praise from all who witnessed their behaviour ; and proving themselves worthy of fighting alongside the troops of their "ancient ally." Lord Wellington, in his despatch, paid a generous tribute to the gallantry of the Portuguese, concluding with these memorable words :—"They have proved that they are worthy of contending in the same ranks with British troops in this interesting cause, which they afford the best hopes of saving." Perhaps the highest compliment paid to the Portuguese troops on that memorable day was by the French General Simon, who, after being taken prisoner, remarked, that it had been a clever ruse dressing up English soldiers in Portuguese uniforms, in order to deceive the French.

It was certainly a novel experience for Napoleon's veterans—who had been accustomed to "walk through" the best troops of the Continent—to meet with such a drubbing as they had received—administered, too, by less than half their own numbers. And what made the pill all the more nauseous was that, of the allied troops who had administered the drubbing, quite half were the despised Portuguese—the "*canaile* that would bolt at the first shot!"

The Battle of Bussaco, viewed in its true perspective, stands out as the turning-point of the Peninsular War. The opinion had widely prevailed hitherto, that a few weeks would see the wreck of the British Army on board its transports in the Tagus. Bussaco had changed everything. The British troops, according to their wont, had behaved nobly. But Bussaco taught the world something infinitely more important than that oft-repeated lesson—"The day gave the Portuguese confidence in themselves and with the army in general," as a British cavalry officer expressed it. It was the right

* A distinguished German, discussing the spirit of pessimism which at one time prevailed in England, as to the outcome of the struggle, wrote :—"Why are the English so gloomy in their forebodings of the issue of this war?—Because their happy constitution, combined with English spleen, engenders in them a peculiar foolish tendency, and makes them the greatest calumniators of themselves. The Briton disparages himself, ignores his own merits, exaggerates his deficiencies, and is always ringing the alarm-bell."

Digitized by Google

interpretation of this lesson that enabled Wellington to stem the flood of invasion at the Lines of Torres Vedras, and thence to march, from victory to victory, until, four years later, he was able to dictate terms of peace to the tyrant of Europe on French soil.

It was on that glorious field that the Portuguese began that companionship-in-arms which lasted till the close of the war. Had they shown their backs to the foe on that fateful day—as was foretold, aye, and hoped for by the opposition in England—the Peninsula must have been abandoned forthwith.

What were Lord Wellington's views in respect of the battle? Writing, a few days afterwards to the Rt. Hon. W. Pole, he observes:—"The croakers about useless battles will attack me again on that of Bussaco, *notwithstanding that our loss was really trifling; but I should have been inexcusable if, knowing what I did, I had not endeavoured to stop the enemy then*, and I should have stopped him entirely if it had not been for the blunders of the Portuguese General commanding in the North, who was prevented by a small French patrol from sending Trant up the road by which he was ordered to march. If he had come by that road, the French could not have turned our position, and they must have attacked us again: they could not have carried it and they must have retired. . . . To this add that the battle has had the best effects in inspiring confidence in the Portuguese troops, both among our croaking officers and the people of the country. This likewise removed an inference which began to be very general, that we intended to fight no more, but to retire to our ships: and it has given the Portuguese troops a taste for an amusement to which they were not before accustomed, and which they would not have acquired if I had not put them in a very strong position."

Bussaco, Sept. 28. Remained under arms all day; the enemy appear to be making a number of movements, that end in their turning our left flank, and obliging us to retire, which we did in the night by torch-light, and in great confusion.

A night-retirement, by torch-light, through the Convent woods, over the rough, precipitous tracks—hardly deserving the name of roads—in the rear, would naturally entail some confusion. And this is confirmed by Capt. Burgoyne, of the Engineers, who was attached to Picton's Division. Orders for retirement were only received at 1 a.m., on the 29th:—"It was a rainy night, the road was very bad, and we found much confusion in Genl. Leith's part of the line . . . some regimental pickets not called in, etc. . . . Our pickets which were to have retired in a body at daylight, finding this confusion, did not march off till 8; they destroyed 36 barrels of ammunition found in the rear of Genl. Leith's ground, and recommended a Portuguese Regt. of Militia which was on the heights, *and had received no orders*, to retire."

(*To be continued*).

Digitized by Google

REVIEWS.

GUNNERY.

By Capt. J. C. Wise, *U.S.A. Volunteers.*

This is of course an elementary book as far as gunnery is concerned. There is an excellent introduction on "The Study and the Value of Theory," which is well worth reading.

Part I. then consists of "An Elementary Course of Mathematics for Field Artillerymen," which occupies 55 pages. It is clear, but, as its title implies, is elementary enough for one who has done little school work, or has forgotten what he did at school.

The rest of the book is on the same lines; it touches practically no mathematics, and is therefore of use to the man who wants to learn about explosives, field artillery training and gunnery without any mathematics to trouble him. There are no gunnery tables, and no explanations as to how these are put together, and how range tables are compiled and made use of. The chapter on "Indirect Fire and Deflection" occupies some 38 pages, the illustrations are numerous and good, and this chapter is excellent and most useful for a field artilleryman. A good index at the end enables a reader to quickly find the part of the book he requires.

C.E.P.

THE PRINCIPLES OF STRUCTURAL MECHANICS.

By Percy J. Waldram, *Lecturer at the Central School of Arts and Crafts, London.*—(B. T. Batsford. 7s. 6d.).

It is claimed that this book contains a practical explanation of the construction and application of formulæ and rules in ordinary use for determining the strength and stability of structures without the use of higher mathematics. A timely warning is issued with regard to the danger of misapplying formulæ through only partially understanding them. As a matter of fact the reasoning given is so simple, and the expressions deduced for the results follow so clearly, that in reading the book "formulæ" scarcely seem to be encountered. The author analyzes the conditions of the various problems thoroughly from first principles, and holds aside the mathematical curtain with which text-books usually enshroud them. The reader with only very elementary mathematical knowledge and no previous ideas as to the action and result of forces, should have no difficulty in following the book. The elements of statics are clearly explained, and then, after consideration of bending moments and moments of resistance, shear and deflection, the novice is easily and quickly led to the solution of problems connected

Digitized by Google

with such structural designs as plate and girder bridges, retaining walls, roofs, domes and arches. Stress is laid on the importance of shear, and the analysis of its action is commendably clear—a strong point in favour of the book, as this is a subject which is often made so mysterious to the tyro that he is inclined to disregard it, being afraid to tackle it at all. The action of wind pressure is summarized from recent experiments at the National Physical Laboratory, and useful and concise data are tabulated for the solution of problems affected by it. The subject of columns is carefully treated, and the book concludes with a practical chapter on shoring. We can confidently recommend the book to those making a first study of the subject, as also to those who have been rushed through it and tried to cram it up without grasping its elements. It is to be hoped that the author will fulfil his intention of issuing a companion volume with examples of practical calculations and working drawings showing the application of the theories he has so clearly investigated.

A.S.R.

BUILDING CONSTRUCTION.

By CHARLES F. MITCHELL, *Lecturer on Building Construction to the Regent Street Polytechnic, London.*—(Advanced Course, seventh edition, 1912. Published by B. T. Batsford. 6s.).

THIS new edition has been called for by the effects of the L.C.C. Regulations in connection with Skeleton Frame Buildings, and the L.C.C. proposals with regard to Reinforced Concrete—the chapters devoted to these subjects have been re-written.

The bulk of the Second Report with the standard notation of the R.I.B.A. Joint Committee on Reinforced Concrete is included.

This book like its companion volume, the Elementary Course by the same author, has been designed to meet examination needs as well as the requirements of those employed on practical building work.

A.S.R.

BUILDING CONSTRUCTION AND DRAWING.

By CHARLES F. MITCHELL, *Lecturer on Building Construction to the Regent Street Polytechnic, London.*—(Elementary Course, eighth edition, 1911. Published by B. T. Batsford. 3s.).

THIS book gives greater detail of certain structural items than previous editions, and embodies quotations from the L.C.C. General Powers Act, 1909, and the New Rules for the admeasurement of Slating and Tiling.

The chapters and arrangement have not been altered, but the letterpress has been increased by 22 pages. The examination papers for the elementary stage of the Board of Education, South Kensington, have been added down to May, 1911. It is the syllabus for this examination, as well as the needs of the practical builder, that this book has been designed to meet.

A.S.R.

Digitized by Google

NOTICES OF MAGAZINES.

Revue d'Artillerie.

May, 1912.

Quick-Firing Siege Guns of Large Caliber.—This article is written by Capt. Pelloux, of the Artillery, and is illustrated by five good photographs and a diagram. After enumerating the general requirements of siege guns, he proceeds to describe the 105-m.m. ($4\frac{1}{8}$-in.) gun and gives the following particulars:—

Table.

Weight of projectile	k.g. 16 = $35\frac{1}{4}$ lbs.
Initial velocity	m. 615 = 2,018 f.s.
Muzzle energy	t.m. 308·4 = 455 ft. tons.
Height of line of fire	m.m. 1,830 = 6′.
Amount of elevation	deg. − 5 to +40.
„ „ training	„ 6.
Diameter of wheels	m.m. 1,500 = 4′ 11″.
Track	„ 1,524 = 5′ about.
Weight of gun	k.g. 1,090 = $21\frac{1}{2}$ cwt. nearly.
„ „ breech piece	„ 35 = 77 lbs.
„ „ carriage complete	„ 1,955 = $38\frac{1}{2}$ cwt.
„ „ one wheel	„ 125 = 2·46 „
„ „ shield (6 m.m.) (= $\frac{1}{4}$″) ...	„ 160 = 3 „
„ „ gun in battery	„ 3,045 = 60 „
„ „ limber	„ 3,375 = $66\frac{1}{2}$ „
„ „ wagon limber (22 rounds)	„ 1,080 = $21\frac{1}{4}$ „
„ „ wagon (42 rounds) ...	„ 1,615 = 31·8 „
Maximum range	m. 11,450 = 12,522 yds.
Rounds per minute	10 to 12.

After this follows a description of the 150-m.m. (6-in.) quick-firing siege gun. This gun is fitted with a variable recoil. The full recoil of 2 metres is allowed between the maximum depression, and an elevation of 14°, and a reduced recoil from +20° to the maximum elevation. Between +14 and +20 the recoil varies. A full description of the arrangement, with a diagram, is given. The gun carriage and limber are also described.

Digitized by Google

Table.

Weight of projectile	k.g. 40 = 88¼ lbs.
Initial velocity	m. 6·45 = 2,116 f.s.
Muzzle energy	t.m. 848 = 2,643 ft. tons.
Height of line of fire	m.m. 1,830 = 6′.
Extent of elevation	deg. − 5 to + 40.
„ „ training	„ 4·3.
Diameter of wheels	m.m. 1,500 = 4′ 11″.
Width of track	„ 1,524 = 5′ about.
Weight of gun complete	k.g. 2,475 = 50 cwt. nearly.
„ „ breech	„ 67 = 147¾ lbs.
„ „ carriage complete	„ 2,960 = 60 cwt. nearly.
„ „ one wheel	„ 148 = 3 „ „
„ „ shield (6 m.m.)	„ 160 = 3 „
„ „ gun in battery ...	„ 5,435 = 107 „
„ „ filled carriage	„ 3,860 = 76 „
„ „ limber	„ 3,290 = 65 „
Maximum range...	m. 12,600 = 13,780′.
Rounds per minute	4 to 5.

ITALY.—*Throwing Projectiles from an Aeroplane on the Enemy in the Field.*—The Turco-Italian War has provided the aeroplane with the opportunity of showing its capabilities, not only as an instrument of reconnaissance but also as an offensive instrument in actual warfare, and the experiences of the Italians in Tripoli are therefore the more interesting.

Several years ago experiments were made with a grenade charged with picrate of potassium. These experiments, which cost their author his life, have since been continued at Spezzia with grenades of the size of an apple. To throw the grenade it is made to slide along a wire the end of which is secured to a catch; when the grenade arrives at the end the catch opens and releases it. The grenade bursts on hitting any resisting body. Other experiments have been tried, such as allowing cylindro-conical grenades to fall from the top of a viaduct. The effects have been extremely destructive within a circle of 20 metres radius.

The bombs actually used in Tripoli are cylindro-spherical in shape, the spherical portion is very heavy and remains below during the fall. They are charged with picric acid and balls, and their weight is about 10 k.g. (22 lbs.). They are fitted with a handle for throwing. These projectiles would be capable of great destructive effects, if the necessity for avoiding the enemy's fire did not involve the aviator flying at a height of about 1,000 metres. The result is that the aim is uncertain, and in many cases the bomb buries itself before bursting, which considerably diminishes the effect. To obviate the latter defect experiments are now being carried out by the Italians at Viareggio and Fontana Liri with fuzed bombs, which burst about 15 seconds after discharge. A premature explosion is very dangerous for the aeroplane and pilot, and the effect on the enemy when they burst too high is very small. Attempts are now being made to ensure a burst at about 20 metres from the ground.

Digitized by Google

EXTRACTED FROM VARIOUS GERMAN PERIODICALS.—An article in the *Streffleurs Militärische Zeitschrift* gives some interesting details about the Russian artillery in Manchuria. Out of 1,400 quick-firing guns with recoil buffers which took part in the campaign, 129 (about 9 per cent.) were lost in action and 83 (or 6 per cent.) were disabled. It is calculated that an average of 2,000 rounds sufficed to render a gun useless. (On the other hand it is recorded that a Krupp 75-m.m. gun fired 7,000 rounds without its initial velocity being much impaired, and in France it is often stated that 75-m.m. guns will fire 4,000 rounds without detriment to their quality or accuracy).

It is well known, and even the Russian records support the statement, that the Russians expended enormous quantities of ammunition, opening rapid fire when slow would have sufficed, emptying their wagons on the position to hasten their replenishment, and even burying projectiles which they had not time to use, and could not carry back, or firing simply because the noise gave heart to the combatants. Heavy siege guns and mortars equally squandered their ammunition, sometimes going so far as to fire on single infantrymen. In the Battle of San-de-pu 27 batteries fired 76,000 rounds, (360 per gun) almost double the rounds fired by the German guns at the Battle of St. Privat. At the Battle of Ta-shi-chiao one battery fired 522 rounds per gun during one day, and General Bohre calculates that it took 40 rounds to disable one Japanese. On the Japanese side the largest expenditure in one day was 200 rounds per gun.

June, 1912.

OBSERVATIONS ON THE MANŒUVRES, 1911.—During the month of June the observations of the General Staff on the 1911 manœuvres were issued as hints for the 1912 manœuvres. The following are of particular interest:—

Communications on the Battlefield.—"Communications from the lower to the higher commands leave much to be desired."

"It is indispensable that each unit should keep its next higher commander constantly informed of its situation, its progress, and physical and moral condition. A commander thus enlightened can utilize his reserves and make his decisions with full knowledge of the necessities."

"Communication from above to below is easy at the beginning of an action. The duty of the commander, as soon as his decision is made, is to inform his subordinates clearly of the situation, the end to be attained and to lay down the part to be followed by each."

"During the engagement, communication sometimes becomes difficult. It is therefore highly important that a thorough system should be acquired during peace by practice on the map and in the field, and that complete initiative should be left to all as to the best method of attaining the end that has been assigned to them. In critical moments the connection from above to below is chiefly moral, and is a matter of education and confidence."

"But it is necessary to re-establish the chain at the earliest possible moment by floods of information from below, in the light of which the commander can renew his control of the operations and form new decisions . . ."

Digitized by Google

Artillery.—"The commanders have a reprehensible tendency towards distributing the artillery from the very beginning amongst the subordinate commands. By so doing they deprive themselves of the power of exercising effective influence on the combat."

"Besides, this distribution of the artillery conduces to a strict division of the battlefield into compartments. Employed to fire direct to its front, the artillery cannot employ its powerful weapons of flank and reverse fire, and convergent fire is not realizable."

"The action of masses of artillery does not appear to be sufficiently understood."

"The conduct of the command and employment of important groups of artillery (corps and divisional artillery united under one command) should be practised at war games and during manœuvres . . ."

As will be seen, communication between executives of the different arms is not mentioned. The military virtues emphasized are, the utilization of information received from below, the execution of orders issued from above, and co-ordination of teaching and initiative. No new precept is added to the Provisional Field Artillery Regulations of 1910, and no rules are introduced more strict than those already enjoining mutual support between artillery and the other arms.

As to the employment of artillery, it is satisfactory to note that attention is called to the characteristic properties of artillery, *i.e.* long range and wide field of action. The former enables it to assist troops, from a position far from the line of march, by flanking fire which is often more efficacious, and realized with less danger than direct fire. The mobility of its fire enables the rain of projectiles to be instantaneously changed from one point to another many thousand yards distant, but this power is only at the disposition of the commander if he has not previously disarmed himself, by placing it at the disposal of his subordinates. Artillery is a powerful weapon, but has its weak points. It can accomplish much or may be employed unprofitably.

UMPIRING DURING THE 1912 MANŒUVRES.—The publication of the observations on the 1911 manœuvres was followed by the issue of ministerial directions for umpiring during 1912. The chief point in these directions is that it places the functions of Chief Umpire where they ought to be, that is in the person of the Director of Manœuvres.

Umpiring offers many difficulties, above all in that which concerns artillery. But difficulties must not discourage fresh efforts, and it is to be hoped that those made in 1912 will be completely successful.

One criticism has for several years been addressed to the artillery, and that is that several batteries have been found firing at the same time on the same object, while another equally important object close to it was left unmolested. The conclusion arrived at is insufficient dispersion of fire, bad intercommunication, etc.

This mistake, however, is one that belongs to times of peace. Others may be committed in war, but never this one. The fact is that during manœuvres a battery only fires a few blank rounds, and batteries cannot see where their neighbours' shells are bursting. In war this would be

Digitized by Google

clear to all and sufficient to prevent all superposition of fire, except that which is really intentional.

CONTRIBUTION TOWARDS THE HISTORY OF THE ARTILLERY.—The second article is a contribution towards the history of the artillery, and gives details of the conflict that raged during the first half of the 19th century over the question of allowing senior officers of artillery and engineers to command bodies of troops of all arms whether in peace or war. It is not of sufficient interest to reproduce here.

STUDIES OF GUN FIRE.—This is the second part of an article by Capt. Commandant Eugène Pagezy of the Artillery of the 2nd Cavalry Division. The first part appeared in the *Revue d'Artillerie* for January, 1912, and evidently laid down certain formulæ without which this second part is not very intelligible. It deals with the necessity for cover for the guns and the choice of positions for them, and is illustrated by several diagrams.

SAFETY IN THE AEROPLANE.—By P. Lucas-Girardville, Major of Artillery.—The first problem to be solved with regard to the safety of aeroplanes is to give them sufficient strength to resist the abnormal strains to which they may under certain conditions be subjected during flight. Accidents have occurred that have moved and surprised us. The emotion is natural, the surprise is due to the widespread idea that, as the laws of the strengths of materials are known, it should be easy to apply them to the case of aeroplanes. But the difficulty is that the strains to which the materials may be subjected are not known. All we can say for certain is, that when an aeroplane weighing 400 k.g. is flying horizontally, the vertical component of the pressure of the air is 400 k.g. We can even calculate approximately the centre of pressure. But we do not know how these strains are distributed in the frame, or to what strains the apparatus is subjected in a disturbed atmosphere, or in a sudden check after a swift flight.

After an accident additional strength has been given where it was found necessary, but it is impossible to say what effect this has had on the general strength of the machine, it may even happen that this addition has weakened another part. Through the centuries all crafts have depended upon experiment to prove the strengths of their materials, but the grave results of an accident in the air do not admit of these tests in the case of aeroplanes, nor are they compatible with the rapid evolution of the industry. Besides strength, stability is a factor that requires more study, and both these qualities must be associated in the design.

Till now static tests of strength have been made by placing sand on the wings to represent the pressure of the air, but the difficultiy is that we cannot thus represent actions of which we are ignorant. The result is that accidents have happened to machines thus tested quite as often as to untested machines.

It follows from this that aeroplanes must be tested by the air in aerodynamic proving grounds fitted with apparatus suitable for giving a

Digitized by Google

machine a velocity greater than that of its normal speed, and allowing the reproduction as far as possible of any event that might occur during flight. Instruments for recording the effects produced are also necessary.

Two kinds of proving grounds of this nature have been suggested; one in which the vehicle to which the aeroplane is attached moves along a cable stretched between two points, and the other in which it moves along a railway. One of the former kind has been installed at the Military Aviation Establishment in Vincennes, the result of which has been so satisfactory that the authorities have asked for an aerodynamic cable, 500 metres long and 25 metres above the ground, on which large machines can be tested at their normal speed.

These cables suit perfectly for studying the action of the air on the planes at normal speeds and the strength of the frames, but they are no use for destructive tests, nor for studying the reaction caused by the recovery of the aeroplane after any manœuvres. For such tests an unyielding device is required, with arrangements for varying the slope of the planes. To meet this want, a proving ground with a railway has been suggested. To be of any use the tractor must be sufficiently powerful to drag at 150 kilometres (94 miles) an hour the largest aeroplanes, and so designed that no pressure or sudden break of the latter can upset it off the rails. One great advantage of this rail tractor will be that the experimenter can accompany the aeroplane in safety during its full flight, and produce at will any effect he wishes to study.

Very interesting experiments of this nature have lately been made on the Railway du Nord, by attaching a monoplane to a truck with the spread of the wings at right angles to the direction of its motion. The experimentalists were in another truck and the whole was given a velocity of 106 to 114 k.m. per hour by a locomotive of 1,500 horse-power. But such tests can only be made on open lines along selected sections, for the spread of the monoplane used was 9 metres. They could not be prolonged or often repeated owing to the interference they caused in the regular train service, but they gave useful hints as to the conditions necessary for experiments of this nature.

Of the results of these experiments two points may be mentioned. The first is that all the stays and shrouds of the aeroplane were distorted, and according to calculation the stresses to which they had been subjected were far less than those which had been successfully borne, without any deformation, under the sand test. The second point is that 1,500 horse-power was used. The conclusion to be drawn is firstly the superiority of aerodynamic over static tests, and secondly that the existing installations, the best of which disposes of 80 horse-power only, are insufficient.

The writer then proceeds to advocate certain improvements in the Vincennes establishment, including a cinematograph installation for recording all experiments, and hopes that the results obtained will permit of the laying down of rules for the construction of aeroplanes. The article is to be continued.

Digitized by Google

July, 1912.

The first article is by M. P. Charbonnier, Chief Engineer of the naval artillery, and entitled the Ellipse of Shell Bursts. He refers to an article by Capt. L. Grossmann, of the 4th Regiment, Austrian Artillery, in the latest number of the *Mitteilungen über Gegenstände des Artillerie-und Geniewesens* on time and distance fuzes, and treats the subject somewhat differently. The investigation necessitates the use of the calculi, and is of considerable interest. The ellipse of bursts is due to slight errors in the angle of fire, in the initial velocity and in the ballistic coefficient of the projectile. There appears to be some difference of opinion as to whether it is better to design the fuzes to give an ellipse with the major axis parallel to, or at right angles to, the objective. The former would be more effective against troops in line, the latter against troops arranged in depth.

Initial Velocity in Field Artillery.—By Lantereau du Part, Lieut.-Colonel of Artillery.—The writer queries the necessity for high initial velocities, which he considers belong to large calibre guns only, the projectiles of which maintain their velocity at distant ranges. Where the ranges are determined by the configuration of the ground and the visibility of the objective, he maintains that high initial velocities are not required. The formula $\frac{1}{2}mV^2$ for the *vis viva* sounds well, and is responsible for a great deal of the misunderstanding about the necessity for high velocities. He defines the efficiency of a shrapnel burst and then investigates the factors on which this efficiency depends. From the results of experiments he works out a formula for this efficiency, and from it shows that a 75-c.m. (3-in.) shell at both 2,000 and 3,000 metres range is more effective with a muzzle velocity of 460 than 530 metres.

To answer those who argue that engagements will now commence at 5 or 6 kilometres, since observation by aeroplanes has extended the field of observation, he shows that to raise the power of the gun to give at 5,000 metres the efficiency now obtainable at 3,000 metres, the weight of the gun and carriage must be so increased that it is no longer a field gun.

The third article is a contribution to the history of the Artillery dealing with the right of command of troops and other arms, and is of no particular interest in Great Britain.

Then follows the third and last article on Studies of Fire, for understanding which a perusal of the first and second parts is necessary. The writer completes his investigations of the calculations required to be made by a commander, who is directing his battery from a point at a considerable distance away. The article is interesting.

Security in Aeroplanes.—Last article by P. Lucas-Girardville, Major of Artillery.—The writer discusses the question of automatic and mechanical means for securing stability in aeroplanes. If no automatic arrangements are provided, the strain placed on the pilot in manipulating the mechanical devices is too great, and a small error may bring

Digitized by Google

about an accident. Some automatic devices are necessary, but if these are carried too far and some aerial current diverts the course of the machine, it will be difficult to bring the mechanical appliances into action quickly enough. At high altitudes their action will be sufficiently rapid, but this may not be the case if the deviation in the course of the aeroplanes occurs just as a landing is being effected.

From observation of a recording anemometer it is evident that the pressure of the horizontal component of the air varies between large differences in a few seconds. The barometer does not record these changes of pressure and the general atmospheric pressure must therefore remain the same, the change of pressure in the wind being evidently due to a change in its direction, either lateral or vertical. It is these latter currents—either ascending or descending—that are so dangerous to the flying machine.

It is argued that existing designs of flying machines are wrong, the rudders especially being sources of danger when encountering vertical currents. The writer sums up by laying down as an axiom that the pilot must be protected against the air by flexibility, and against himself by automatic stabilizing devices.

INFORMATION ON VARIOUS SUBJECTS.—An extract is published from an article in the *National Zeitung* of the 13th June, 1912, criticizing the French Field Artillery, which is described as the best arm in the French Army. But the weak point in most of the regiments in the mother country is the low strength in horses. A group of three batteries needs for manœuvres 205 saddle and draught horses, and as each battery only has about 40 it takes five batteries to supply horses for that group, and more if loans of horses of any extent have to be made to the infantry. The result is that only about half the field artillery in an army corps can be taken each year for manœuvres.

Side by side with this void in the means of preparing for war, the organization in the command and tactical superintendence leaves much to be desired, both as regards training and in war.

The reviewer however issues a warning that the defects he points out must not be taken as denoting the inferiority of the French Field Artillery. The article should be well worth perusal in the original German.

At the Michelin aero-cible meeting the prizes of 25,000 and 50,000 francs were both won by a lieutenant in the American Artillery. The conditions of the first contest were, in one single flight over a target, to place the greatest number of shots out of a total of 15 in a rectangle of 120 m. by 40 m. The winner succeeded in getting eight in. For the second-named prize he placed 12 shots out of 15 on a target of 20 m. diameter from a height of 200 m.

PROGRESS IN THE GERMAN ARMY IN 1911.—The peace strength surpassed that of 1910 by 180 officers, 1,225 N.C.O.'s, 2,807 men, and 4,084 horses. Lines of communication troops were particularly

Digitized by Google

developed; the total number of automobiles is 57,800; there are 10 dirigibles all fitted with wireless telegraph apparatus; the issue of the new bridging equipment begun in 1909 was continued; also moving kitchens and mules. Study is being given to a haversack which is proof against rifles, also portable tools for infantry and cavalry, motor-ambulances, and Röntgen ray apparatus for line of communication hospitals, etc.

Various additions to, and improvements in the equipment of, the artillery are noted, including guns for the attack of balloons.

A. R. Reynolds.

Rivista di Artiglieria e Genio.

June, 1912.

Military Transport and the Navigation of Rivers in Italy.—The ancient Romans made large use of the natural waterways for increasing the communications between the people of an immense empire, and constructed wonderful artificial works, such as the port constructed by Claudius, extended by Trajan and placed in communication with the Tiber by means of the Fosse Triania (canal of Fiumicino). During the Roman domination in Gaul, Marius opened a canal between Arles and the sea, and established special corporations to regulate the rights of the boats traversing the principal water courses.

With the fall of the Roman Empire the waterways, as well as the land communications, fell into disuse; and it was not until the epoch of the rise of the Communes that the restoration of the canals, and the improvements in the natural waterways took place. In fact the commencement of the XIIth century was marked by the opening of the great navigable canal of Milan and the canals of Bologna and Modena; and works were constructed which rendered the Mincio open to navigation from Mantua to the Po. From 1100 to 1400 the Brenta was made navigable from Padua to Venice, the Arno from Pisa to the sea, the Ticino and the Adda from Verbano and from Lario to Milan.

With the invention of locks began the movement of the construction of canals which became so active two centuries afterwards, especially in France.

The canals now open for navigation are the new canal of Pavia which unites Milan with the Ticino; the minor canal Polesella between the Po and the Bianco canal; the canal Scortico between the canal Bianco and the Addigetto; the canal Loreo between the Bianco canal and the Adige; the Valle canal between the Adige and the Gorzone; the Bretella between Brenta and Bacchiglione; the canal of Ravenna to Porto Corsini; the Fiumicino canal.

The Modern Conditions of River Navigation in Italy.—The navigable lines in Italy are naturally confined to a few plains; these are:—

Digitized by Google

(1). The plains of eastern Italy watered by the Po with its numerous affluents, and the rivers of Venice. It is in these plains that the greater part of the artificial canals are met with. (2). The plains of Tuscany watered by the Arno which have some artificial canals. (3). The Roman plains, watered by the Tiber which is navigable from Rome to the Fiumicino canal. To the south of these plains there is a network of bridged canals. (4). The plains of Campania.

The total length of the lines of navigation of Italian rivers amounts to 3,000 k.m. of which 1,000 are artificial canals.

The river navigation is generally effected by means of barges drawn by animals, but for some years the system of towing the barges by steam boats has been adopted. Navigation by steamers has been adopted on the great lakes, on the Tiber and sometimes, also, on the Po.

With regard to the commercial movement on the Italian navigable rivers, it may be said that the traffic diminished during part of the XIXth century owing to the number of ordinary roads and railways. Now, however, it being recognized that their navigation is a valuable complement to the railways especially for the transport of a heavy and not very valuable nature, there is a decided improvement in the commerce on the internal navigation.

The following is a short list of the projects by private enterprise for the internal navigation of Italy:—(1) from Milan to Pavia; (2) from Reggio Emilia to the Po; (3) from the Lake Izeo to the Po; (4) from the lake of Garda to the Po.

In 1807 Napoleon approved of a project for a navigable canal from Savona to Alessandria. In 1816 Pasqualini projected a canal to unite the Teneno with the Adriatic. In 1820 Lippi thought to unite the Adriatic and the Mediterranean by a navigable canal supplied with water from Lake Fucino. In 1826 Carlo Afan de Rivera published a project for uniting the Teneno with the Adriatic. In 1824 the engineer Michelotti projected a canal from the Mediterranean to Lake Maggiore, starting from Albenga along the valleys of Tanaco, the Po and the Ticino.

The following projects were also initiated by the Government for river navigation.

In 1905 and 1909 a commission published 18 splendid volumes rich in data and suggestions for internal navigation. Nine of these were by the technical executive committee presided over by the Hon. Romarius Jacur; three by the economic-administrative committee, president General Bigotti; and three others by the commission appointed to study the subject in foreign countries. The recommendations of these commissions were:—(1). To make the greatest possible improvements for navigation in the river Po. (2). To increase the internal navigation of waterways of primary importance as far as Turin and the lakes. (3). To open out a plan of a network of navigable canals from the Alpine lakes, to the eastern confines of the kingdom, touching all the more important centres of commerce and production in Northern Italy, and opening up the navigation not only to the Adriatic, but also to the Mediterranean.

Digitized by Google

River Navigation and Military Transport.—It is only by a good system of ways of communication, that an army can be assured of the supply of reinforcements and provisions, as well as the transport of the sick and wounded and prisoners whose presence hinders the movement of the columns.

Some Historic Examples.—The genius of Napoleon fully recognized the value of waterways, and of every kind of military transport tending to make strategical movements more rapid. Entering into Italy in 1796 with 30,000 men he at once separated the Piedmontese from the Austrians at Montenotte and at Millesimo; embarrassing the first and imposing upon them the armistice of Cherasco, and following the latter so that they hastened to cross the Po, and throw themselves into Lombardy His first care on touching the right bank of this river near Piacenza was to requisition all the barges and boats. Although the Austrians had taken the precaution of destroying as many as possible, Generals Angereau and Massena arrived in a short time and collected a sufficient number to throw a bridge across the river. On the 9th May, Napoleon's army crossed the Po at Piacenza, then the Adda at Lodi, thus seizing Lombardy. Buonaparte remained here for a short time collecting resources of every kind supplied by this rich region, and collected these in the magazines, arsenals and hospitals along the Po. Continuing his successes he moved on the line of the Adige; all the left bank of the Po up to Mincio remained in his power. For the security of the right bank he concluded treaties with the Duchies of Parma and Modena. Many other instances are given to show the wonderful foresight and organization of Napoleon with regard to the river navigation and that of the lakes during his Italian campaigns.

The experience gained during the Franco-Prussian War of 1870–71 shows that there was much disorder and inconvenience owing to too much reliance being placed on the railways, especially in the conveyance of stores and ammunition, etc., the railway service being almost entirely taken up in carrying the troops. It is of the first necessity to be able to come to the assistance of the railways which are always overworked. The example of all modern wars, and especially that of 1870, shows this very clearly. In order to make proper use during war of the navigable waterways it is necessary to study during peace times the service and traffic of the barges, and all provisions should be made during war for guarding the various waterways, and for their destruction and repair.

The great river of Italy, the Po, enters at once into consideration as most important for transport of every kind during war, and, with this view, projects should be based in time of peace so that it may not have to be used without preparation as happened in 1848 and in 1866.

As has been well said by General Bigotti, the first pioneer of internal navigation, "when a war happens either in the east or in the west, the network of rivers and canals of the valley of the Po should be of valuable assistance to the railways, which latter being relieved of the transport of a part of the material with which they would be encumbered would be more usefully employed in the transport of the combatants."

Digitized by Google

July—August, 1912.

DESERT WARFARE.—*La Revue Internationale*, in its supplement for July, publishes an article by Capt. Boyer in which the author basing his experience on the campaign carried out by Germany in South-West Africa, explains with much clearness the difficulties which European nations have to encounter in the conquest of African territory. The treachery of the natives, their methods of conducting war, the insanitary soil and climate in which the European troops are engaged, are all matters of real importance.

The author commences his article with a saying of General Leutwein during the German campaign against the Hereros in 1904, viz. "that it is easy to commence an African war but difficult to finish it."

A nation which has the supremacy of the sea finds no difficulty in occupying the coast, and the African maritime towns; the real strife commences when she proceeds to the conquest of the interior.

An army taught on the principles of modern European warfare, finds itself confronted with absolutely new conditions. The maps are inexact, ways of communication do not exist, objective and strategical points on which to direct the troops are entirely wanting. All this causes uncertainty in the operations of war. The enemy also carries on the war in a special way of his own. He does not wish to engage in regular battles, but seeks to tire out his adversary, obliging him to make long marches and détours; then when he thinks him sufficiently weakened, he attacks his rear. And while a colonial war signifies an increase of expense becoming greater day by day for the nation engaged, time has no value to the natives, especially the Arabs. An African war therefore to obtain satisfactory results requires great efforts on the part of the European troops, and is a severe trial of patience.

It is necessary also to keep in mind that the native enemy, even when inferior in number and equipped with less perfect weapons, has great advantages over white troops in his thorough knowledge of the ground, enabling him to make use of small resources which are wanting to his pursuers. Also, being mounted on animals accustomed to the climate and more mobile, he is able to see and observe the movements of his adversary much better than the Europeans can discover him. Being friendly with the population, he can surround the columns with a network of spies who inform him of everything that may be useful to him.

In this kind of warfare it is very important to know how to discover the traces left by men and animals, which the natives can do with wonderful accuracy. All the astuteness of guerilla warfare is known to them; the morning attack from the east, and the attack in the evening from the west, because the enemy is then harassed by the sun in his face; at night before stretching himself on the ground a native listens for and avoids sounds; concealing himself behind a rock or in the sand of the desert, ready to fire on a passing patrol without the latter being able to see where the shots come from. In this kind of warfare the native is superior to the European, and the author states that in their operations in the south-west of Africa, the Germans had to give up patrols altogether so as to reduce their losses.

Digitized by Google

Even in the matter of signalling the natives do not seem inferior to the Europeans. The African natives are wonderfully well acquainted with special signals: chiefly by fires and smoke. Also in other small particulars which do not seem to be of great importance, for instance heaps of stones on the edge of a road or path, are sometimes used as signals, especially if native traitors are found in the service of the invaders.

Any European nation, which disembarks on an African coast its strong brigades and divisions, finds too soon that these armed masses will not be able to advance into the interior of the country. It is necessary to follow and come into touch with the enemy with a part of the available force, and to work only in small columns owing to the wretched state of the paths, the want of water, and the great difficulties of transport. But above all, the want of water is what hampers the decisions of the commander, and makes so many of his schemes impossible.

The horses, mules, and oxen are naturally useless if deprived of water; and to a certain extent the camels also, besides requiring special nutriment and care.

Lastly, great difficulty is met with in the provision for the commissariat. The country offers no resources, and it is necessary to replenish the troops with ammunition, clothing and equipment. There is also need to transport water, wood, benzine for the automobiles and aeroplanes, hydrogen for the dirigibles, etc. An enormous convoy is thus formed following each column and having to traverse the interior of the African continent: a convoy which burdens the troops and restrains their movements, making them entirely dependent on the lines of communication.

The further the troops are distant from their bases of operations the greater the difficulty becomes; and it may be added that the reprovisioning convoys require escorts for security, and it is necessary to provide supplies for men and animals for the columns and escorts, and these have to be subtracted from the loads carried by the convoys. From time to time as the distance increases from the base of operations, it becomes necessary to establish stations and depôts along the line of march, and these naturally require men to guard them.

The draught animals employed in transport suffer much from the African desert sand, and days of rest are required or they would die from exhaustion, as the supplies of fodder carried with them are not sufficient for their nourishment. The author cites an example during the campaign against the Hottentots. Along one line of march only the Germans lost half a million of marks in draught oxen. These animals died in such great numbers from want of proper fodder, that the smell from their decomposition filled all the *Pad*. Again, the slowness of movement of the convoys presents a great obstacle because, whilst the troops can march about 5 k.m. in the hour, the carts can only do 2 or 3 in the deep sand, frequent rests being necessary for the animals.

A special fact to be considered in warfare in the African forests is that the natives are well acquainted with the paths and tracks. They know perfectly when to find a convoy at a disadvantage.

If a column is required to advance quickly, it has to leave an escort for the convoy which has to be very strong so as to ensure the

Digitized by Google

safety of the latter: thus the column is reduced to a few troops. In fact, as the author says, from 15,000 men that Germany had in the south-east of Africa, the strength of some of the columns did not exceed 800. Nor must the losses due to sickness be forgotten. War in the desert claims many victims owing to the impossibility of obtaining proper medicines and medical appliances, added to which are the illnesses caused by thirst, bad climate, and tropical heat. If there is not a sufficient supply of water for drinking there certainly will not be enough for washing, and, as this frequently happens, it is impossible to provide for personal cleanliness. There is also the moral influence in desert warfare which tells heavily on the spirits of the troops: for days, weeks, and months they traverse wide areas, deprived of all necessaries, seldom seeing the enemy against whom they march, so that gradually they begin to imagine that all their efforts are fruitless.

The heat enervates the soldier, the monotony deprives him of his usual gaiety, and an unconquerable weariness takes the place of his enthusiasm and vigour.

In this warfare great importance must be attached to the modern technical appliances which are at the disposal of armies. The field telegraph and telephone lines render valuable services to the operating columns, by corresponding with the base of operations and the commander-in-chief; but their working is much interrupted by damage caused by wild beasts, by the convoy animals and by the enemy. In the African campaign in the south-east the Hottentots frequently broke the telegraph and telephone wires and ambushed the patrols that were sent for their repairs.

A more secure result, but a slower one was obtained by visual signalling, across the transparent African atmosphere it was possible to read signals at a distance of 50 k.m. by day, and 150 k.m. by night with acetylene lights.

Wireless telegraphy also was of the greatest use: the field radiotelegraph apparatus was well able to accompany the columns and added to other means was able to correspond with the base of operations at the coast. The Germans in their South African campaigns have been able to correspond to a distance of 300 k.m.

With regard to aviation the author thinks that it is difficult to foresee the importance that this may assume in desert warfare; it may become a decisive factor especially with bold aviators. In the African campaigns of the Germans, the use of automobiles has not proved a success owing to the fine sand of the desert penetrating the delicate parts of the mechanism.

E. T. THACKERAY.

Digitized by Google

INDEXED
JUL 25 1912
V.16
1912

THE ROYAL ENGINEERS JOURNAL.

Vol. XVI. No. 1. JULY, 1912.

CONTENTS.

	Page.
1. A Portable Field Girder, and a Simple Method of Launching. By Bt. Major R. L. McClintock, D.S.O., R.E. (*With Photos*)	1
2. An Engineer Officer under Wellington in the Peninsula.—The Diary and Correspondence of Lieut. Rice Jones, R.E., during 1808–9–10–11–12. Edited by Capt. the Hon. H. Shore, late R.N.	9
3. Pasley's "Essay on the Military Policy of the British Empire."—Contemporary Criticisms, 1810—1813. By Col. B. R. Ward, R.E.	23
4. A Lady's Experiences in the Great Siege of Gibraltar (1779–83) (*concluded*). Edited by Col. E. R. Kenyon, R.E.	31
5. Memoirs:—General Sir Alexander Taylor, G.C.B., Royal Engineers (Bengal) (*concluded*). By Col. Sir Edward Thackeray, K.C.B., V.C., late R.E. (Bengal)	51
Lieut.-Colonel Albert Charles Smith, R.E. By H.M.V. (*With Photo*) ...	61
6. Transcript:—The Group System of Fortification Applied to Fortresses. (Translated from the *Inzenerni Zurnal* by Lt.-Col. F. E. G. Skey, R.E.). (*With Plates*)	67
7. Reviews:—*The Civil Engineer's Cost Book.* By Major T. E. Coleman, Staff for R.E. Services	75
The Ruins of Mexico. By Constantine Geo. Rickards	75
8. Notices of Magazines	76

CHATHAM:
Royal Engineers Institute.
TELEGRAPHIC ADDRESS: SAPPER, CHATHAM.
Agents and Printers: W. & J. Mackay & Co., Ltd.
LONDON:
Hugh Rees, Ltd., 119, Pall Mall, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

THE

Royal Engineers Journal

Can now be obtained at

Messrs. HUGH REES, Ltd.,

119, Pall Mall, S.W.

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

Telephone No.—East 53. Telegraphic Address:—"Constructive Ironworks, London."

MATTW. T. SHAW & CO., Ltd.,

MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Digitized by Google

INDEXED UDA

AUG 12 12

THE ROYAL ENGINEERS JOURNAL.

Vol. XVI. No. 2. AUGUST, 1912

CONTENTS.

	Page.
1. A Field Drawbridge. By Capt. E. K. Molesworth, R.E. (*With Photos*) ...	81
2. The Influence of High Ground in Defence. By D.O.L.F.	83
3. Some Royal Engineer Orders at the Siege of Gibraltar...	87
4. An Engineer Officer under Wellington in the Peninsula (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired	93
5. Historical Documents of Major-General Sir J. T. Jones, Bart., K.C.B., R.E. (*concluded*)	107
6. Memoir:—Major-General E. R. Festing, C.B., F.R.S. By Col. Sir Colin C. Scott-Moncrieff, K.C.S.I., K.C.M.G., LL.D., late R.E. (*With Photo*) ..	121
7. Transcripts:—My Recollection of an Indian Battlefield. By Capt. M. Power	125
The Demolition of Wire Entanglements by Means of Explosives. (Translated from the *Injenerni Jurnal* by Lt.-Col. F. E. G. Skey, R.E.)	137
8. Correspondence:—Note on Experimental Models of the Armstrong Propeller. By Lt.-Col. J. A. Armstrong, late R.E.	141

CHATHAM:
Royal Engineers Institute.
TELEGRAPHIC ADDRESS: SAPPER, CHATHAM.
Agents and Printers: W. & J. Mackay & Co., Ltd.
LONDON:
Hugh Rees, Ltd., 119, Pall Mall, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

THE

Royal Engineers Journal

Can now be obtained at

Messrs. HUGH REES, Ltd.,

119, Pall Mall, S.W.

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

Telephone No.—East 53. Telegraphic Address:—"Constructive Ironworks, London."

MATTW. T. SHAW & CO., Ltd.,
MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Digitized by Google

INDEXED
SEP 13 1912
VDA

THE ROYAL ENGINEERS JOURNAL.

Vol. XVI. No. 3. SEPTEMBER, 1912.

CONTENTS.

		Page.
1.	**The Survey of Pemba.** By Capt. J. E. E. Craster, R.E. (*With Photos and Plate*)	145
2.	**The Military Archæology of Kent.** By Major A. M. Henniker, R.E. (*With Plates*)	155
3.	**An Engineer Officer under Wellington in the Peninsula** (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired	171
4.	**Memoir:**—Lieut.-General Sir Gordon Douglas Pritchard, K.C.B., Colonel Commandant, R.E.	183
5.	**Transcript:**—Report on Artificial Illuminants, other than Electric, suitable for Barracks Workshops and Large Open Spaces.—(*To be continued*). By Capt L. N. Malan, R.E. (*With Plate*)	187
6.	**Review:**—*The Story of Jerusalem.* By Col. Sir C. M. Watson, K.C.M.G., C.B., M.A., etc. Illustrated by Genevieve Watson. (E.H.H.)	201
7.	**Notices of Magazines**	203
8.	**Recent Publications of Military Interest**	209
9.	**Books Received**...	21

CHATHAM:
Royal Engineers Institute.
Telegraphic address: Sapper, Chatham.
Agents and Printers: W. & J. Mackay & Co., Ltd.
LONDON:
Hugh Rees, Ltd., 119, Pall Mall, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

R.E. Institute Publications.

The SOLE AGENTS for the Sale of the whole of the above are

W. & J. MACKAY & Co., Ltd., Chatham,

And to whom all but Members of the R.E. Institute should apply.

THE
Royal Engineers Journal

Can now be obtained at

Messrs. HUGH REES, Ltd.,
5, Regent Street, S.W.

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

Telephone No.—East 53. Telegraphic Address:—"Constructive Ironworks, London."

MATTW. T. SHAW & CO., Ltd.,
MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Digitized by Google

INDEXED

THE ROYAL ENGINEERS JOURNAL.

Vol. XVI. No. 4. OCTOBER, 1912.

CONTENTS.

		Page.
1.	**Abor Suspension Bridges.** By Lieut. A. F. Chater, R.E.	217
2.	**Concentration of Troops by Rail.** By Major H. F. E. Freeland, M.V.O., R.E. (*With Plates*)	219
3.	**Electric Lighting for Motor Cars.** By Lieut. G. L. Hall, R.E.	233
4.	**Synchronization of Clocks and the Importance of Correct Time.** By Major W. A. J. O'Meara, C.M.G., late R.E.	243
5.	**An Engineer Officer under Wellington in the Peninsula** (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired	261
6.	**Transcripts:**—Specialization of Engineer Services in the Austrian Army. By Major A. H. Ollivant, G.S.	271
	Report on Artificial Illuminants, other than Electric, suitable for Barracks, Workshops and Large Open Spaces (*concluded*). By Capt. L. N. Malan, R.E.	273
7.	**Review:**—*Military Hygiene and Sanitation.* By Col. Melville, R.A.M.C. (A.M.H.)	283
8.	**Notices of Magazines**	284
9.	**Correspondence:**—A Field Drawbridge. By Capt. E. K. Molesworth, R.E. ...	287
	The Story of Jerusalem. By D.C.W.	287

CHATHAM:
Royal Engineers Institute.
TELEGRAPHIC ADDRESS: SAPPER, CHATHAM.
AGENTS AND PRINTERS: W. & J. Mackay & Co., Ltd.
LONDON:
Hugh Rees, Ltd., 5, Regent Street, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

R.E. Institute Publications.

The SOLE AGENTS for the Sale of the whole of the above are

W. & J. MACKAY & Co., Ltd., Chatham,

And to whom all but Members of the R.E. Institute should apply.

THE
Royal Engineers Journal

Can now be obtained at

Messrs. HUGH REES, Ltd.,
5, Regent Street, S.W.

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

Telephone No.—East 53. Telegraphic Address:—"Constructive Ironworks, London."

MATTW. T. SHAW & CO., Ltd.,
MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Digitized by Google

INDEXED

THE ROYAL ENGINEERS JOURNAL.

Vol. XVI. No. 5. NOVEMBER, 1912.

CONTENTS.

		Page.
1.	**Field Troop Summer Training, 1912.** Compiled by Capt. H. J. Elles, R.E. (*With Map*)	289
2.	**Gravitational Shunting.** By Lieut. J. W. J. Raikes, R.E. (*With Plate*)	315
3.	**Cost of Well Sinking at the Tangri River Bridge, North Western State Railway.** By Major E. Barnardiston, R.E. (*With Plate*)	323
4.	**An Engineer Officer under Wellington in the Peninsula** (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired	325
5.	**Transcript:**—The Source of the Nile. By Col. Sir Chas. M. Watson, K.C.M.G., C.B., M.A., late R.E.	337
6.	**Correspondence:**—Roll of the Corps. By Major H. Biddulph, R.E.	349
7.	**Recent Publications of Military Interest**	350
8.	**Books Received**	360

CHATHAM:
Royal Engineers Institute.
Telegraphic address: Sapper, Chatham.
Agents and Printers: W. & J. Mackay & Co., Ltd.
LONDON:
Hugh Rees, Ltd., 5, Regent Street, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

Telephone No.—East 3754 (2 Lines). Telegraphic Address:—"Constructive Ironworks, MILLEAST, LONDON" (3 words only chargeable).

MATTW. T. SHAW & CO., Ltd.,
MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Crown 8vo., cloth gilt, 630 pages. PUBLISHED NOV., 1912.

EIGHTH EDITION. THIRTIETH THOUSAND.

THE
TRUTH of CHRISTIANITY

BY LT.-COL. W. H. TURTON, D.S.O., LATE R.E.

2/6 net, of all Booksellers.

Opinions of the Press:

"Really excellent little work."—*Daily News.*

"Carefully thought-out little work . . . written with frank and tolerant impartiality."—*Standard.*

"The arguments are admirably marshalled; difficulties are not evaded, but met fairly."—*Westminster Review.*

WELLS GARDNER, DARTON & CO., LIMITED, 3, PATERNOSTER BUILDINGS, LONDON.

Digitized by Google

INDEXED
DEC 13 12

THE ROYAL ENGINEERS JOURNAL.

VDA

Vol. XVI. No. 6. DECEMBER, 1912

CONTENTS.

		Page.
1.	**Notes on Bridge Repairs.** By Capt. W. N. Borton, R.E.	361
2.	**Mechanical Transport for Military Purposes.** By Capt. R. K. Bagnall-Wild, late R.E.	371
3.	**Economy in Construction: Some Suggestions.** By Lieut. E. St. G. Kirke, R.E....	377
4.	**Notes on Wind Pressure on Roofs.** By Lieut. C. R. Satterthwaite, R.E. ...	385
5.	**Motor Fire Brigade Apparatus.** By Capt. E. H. Harvey, late R.E.	391
6.	**An Engineer Officer under Wellington in the Peninsula** (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired. (*With Plates*) ..	399
7.	**Reviews:**—*Gunnery.* By Capt. J. C. Wise, W.S.A. Volunteers. (C.E.P.) ...	409
	The Principles of Structural Mechanics. By Percy J. Waldram. (A.S.R.)	409
	Building Construction. By Charles F. Mitchell. (A.S.R.) ...	410
	Building Construction and Drawing. By Charles F. Mitchell. (A.S.R.)	410
8.	**Notices of Magazines**	419

CHATHAM:
Royal Engineers Institute.
TELEGRAPHIC ADDRESS: SAPPER, CHATHAM.
Agents and Printers: W. & J. Mackay & Co. Ltd.
LONDON:
Hugh Rees, Ltd., 5, Regent Street, S.W.

PRICE: 1s. 6d. POST FREE. ANNUAL SUBSCRIPTION: 15s. PAID IN ADVANCE.

Digitized by Google

BULLIVANT & CO., Ltd.,

MAKERS OF

STEEL WIRE ROPES

FOR CRANES, LIFTS, HOISTS, WINDING and HAULING, Etc.
DURABLE AND RELIABLE.

BULLIVANTS' Wire Rope Suspension Bridges. Specially adaptable for long spans over Rivers, combining great strength with minimum weight and cost.

BLOCKS, PULLEYS, AND ALL WIRE ROPE APPLIANCES.

Reg. Offices: **72, Mark Lane, E.C.** Works: **Millwall, London, E.**

Telephone No.—East 3754 (2 Lines). Telegraphic Address:—"Constructive Ironworks, MILLEAST, LONDON" (3 words only chargeable).

MATTW. T. SHAW & CO., Ltd.,

MILLWALL, LONDON, E.

CONSTRUCTIONAL STEELWORK,
FRAMED BUILDINGS, BRIDGES, ROOFS, Etc.

Large Stocks of Joists, Channels, Angles, Tees, Flats, Plates, Chequers, Rounds, Squares, Rivets, Bolts, Galvanized Sheets, etc., etc.

VERY PROMPT DELIVERIES GUARANTEED.

Crown 8vo., cloth gilt, 630 pages. PUBLISHED NOV., 1912.

EIGHTH EDITION. THIRTIETH THOUSAND.

THE
TRUTH of CHRISTIANITY

BY LT.-COL. W. H. TURTON, D.S.O., LATE R.E.

2/6 net, of all Booksellers.

Opinions of the Press:

"Really excellent little work."—*Daily News.*

"Carefully thought-out little work . . . written with frank and tolerant impartiality."—*Standard.*

"The arguments are admirably marshalled; difficulties are not evaded, but met fairly."—*Westminster Review.*

WELLS GARDNER, DARTON & CO., LIMITED, 3, PATERNOSTER BUILDINGS, LONDON.

Digitized by Google

BY ROYAL WARRANT.

THE

Goldsmiths & Silversmiths Company

Ltd.

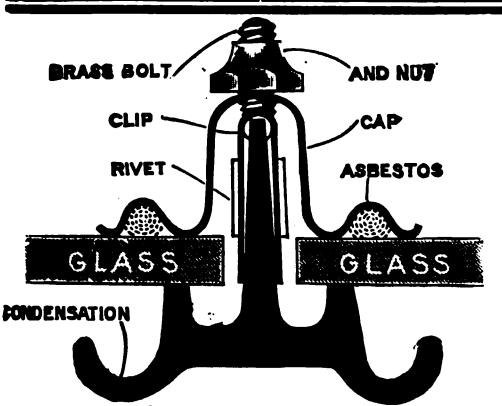
JEWELLERS & SILVERSMITHS
TO
H.M. THE KING.

CHRISTMAS PRESENTS
CHRISTMAS PRESENTS.

THE COMPANY HAVE NOW ISSUED THEIR ANNUAL LIST OF NOVELTIES IN JEWELLERY, SILVER WATCHES, CLOCKS, ETC., SUITABLE FOR XMAS GIFTS. WHICH, THEY WILL BE PLEASED TO FORWARD POST FREE ON APPLICATION.

THE PUBLIC SUPPLIED DIRECT AT MANUFACTURERS' CASH PRICES.

112, REGENT STREET, LONDON, W.



"ORDINARY" BAR.

THE "PERFECTION"

PATENT GLAZING.

No Putty. No Paint. Imperishable.

Steel Glazing Bars Galvanized or also entirely covered with lead to prevent corrosion.

GUARANTEED WATERTIGHT.

Apply :-

HELLIWELL & Co., Ld., Brighouse YORKS.

Extensively used by H.M. Government for Barracks, Drill Halls, Dock Sheds, Post Offices, Stores, Etc.

THE

Royal Engineers Journal

Can now be obtained at

Messrs. HUGH REES, Ltd.,
5, Regent Street, S.W.

Digitized by Google

SPECIAL NOTICE.

THE EXPANDED METAL CO., *Limited,*

begs to bring to the notice of all those interested in

Metal Lathings for Plasterwork

the fact that it has been granted

PATENT RIGHTS FOR A NEW PROCESS OF MANUFACTURE

by which an **IMPROVED** Diamond Mesh

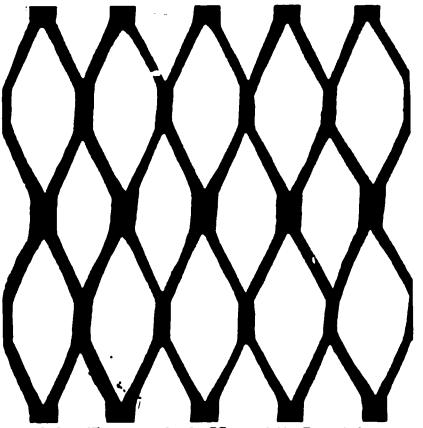
EXPANDED METAL LATHING

is produced, which will be sold at lower prices than the original Diamond Mesh Lathings.

The new patent Lathing will be known under the trade name of

"BB EXPANDED METAL" LATHING

and its principal features are



"BB. Expanded Metal" Lathing.
ACTUAL SIZE OF MESHES.

Write for Price List and Samples.

Expanded Metal Lathings are retailed by Merchants only.

Stocks are held in most large centres.

MESH.—Diamond shape, ⅜in. shortway of mesh.

WEIGHT.—
BB. 26 gauge, 3lbs. per yard super.
BB. 24 gauge, 3¾lbs. per yard super.
BB. 22 gauge, 4½lbs. per yard super.

SIZE OF SHEETS.—Standard size sheets only, 9ft. by 2ft.

PROTECTIVE COATING.—The Lathing is coated with a mineral oil in process of manufacture and is dipped once in Asphaltum paint before leaving the Works.

SPACINGS.—The 26-gauge Lathing may be used at spacings up to 12 inches; the 24-gauge Lathing may be used at spacings up to 15 inches; the 22-gauge Lathing may be used at spacings up to 18 inches, for Horizontal and Sloping work, and for Vertical work the above spacings may be increased by 3 inches.

Head Office
(to which address enquiries should be sent)
York Mansion, York Street,
WESTMINSTER, LONDON, S.W.
Telegrams:—"Distend," London.
Telephones:—Gerrard 819. Victoria 1514.

Works
(to which address orders should be sent)
Stranton Works,
WEST HARTLEPOOL.
Telegrams:—"Expansion," West Hartlepool.
Telephones:—94 West Hartlepool (2 lines).

Digitized by Google

CONTENTS.

PAGE.

1. NOTES ON BRIDGE REPAIRS. By Capt. W. N. Borton, R.E. 361

2. MECHANICAL TRANSPORT FOR MILITARY PURPOSES. By Capt. R. K. Bagnall-Wild, late R.E. 371

3. ECONOMY IN CONSTRUCTION: SOME SUGGESTIONS. By Lieut. E. St. G. Kirke, R.E. 377

4. NOTES ON WIND PRESSURE ON ROOFS. By Lieut. C. R. Satterthwaite, R.E. ... 385

5. MOTOR FIRE BRIGADE APPARATUS. By Capt. E. H. Harvey, late R.E. 391

6. AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA (*continued*).—Edited by Commander the Hon. Henry N. Shore, R.N., Retired. (*With Plates*) 399

7. REVIEWS:—

Gunnery. By Capt. J. C. Wise, U.S.A. Volunteers. (C.E.P.) 409

The Principles of Structural Mechanics. By Percy J. Waldram. (A.S.R.) 409

Building Construction. By Charles F. Mitchell. (A.S.R.) 410

Building Construction and Drawing. By Charles F. Mitchell. (A.S.R.) ... 410

8. NOTICES OF MAGAZINES:—

Revue d'Artillerie. By Lt.-Col. A. R. Reynolds, R.E. 411

Rivista di Artiglieria e Genio. By Col. Sir Edwd. T. Thackeray, V.C., K.C.B., late R.E. 419

Authors alone are responsible for the statements made and the opinions expressed in their papers.

Digitized by Google

Digitized by Google

Royal United Service Institution,

WHITEHALL, S.W.

Contains the best professional Library in the United Kingdom; an excellent collection of Maps and Charts; Reading and Smoking Rooms provided with the leading papers, periodicals, and writing materials; a Museum of Naval and Military relics and trophies; and a Theatre in which lectures upon professional subjects, followed by discussions, are frequently given.

TERMS OF MEMBERSHIP.

ANNUAL MEMBERS, £1 1 0 on entrance, £1 1 0 annually
LIFE MEMBER - - - £15 0 0

Officers whose names appear in the Official Navy and Army Lists become members on payment of the above fees, and applications for membership, giving rank, qualification, and address, should be made to the Secretary.

"THE JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION."

This valuable "Journal" is published monthly, and is sent post free to all Members of the Institution; it is also sent regularly each month to all Naval and Military Attachés, and the principal Foreign Embassies and Legations in London; it is also in the hands of and extensively read by Officers in nearly every Army in the World, as well as Officers of our Colonial Forces.

"The R.U.S.I. Journal" is the Official Organ of the above Institution; it contains the Lectures given in the Theatre, Articles on Professional Subjects, important Naval and Military Notes, also fullest particulars of Naval and Military Inventions, Notices of Books, etc.

The Circulation is more than double that of any Service Publication in existence; it has the largest circulation in India, the Colonies, and also on the Continent of any Service Publication published in the English language; it is widely read, and of great Official importance in most Foreign Countries.

Notes for Officers Proceeding to India.

By Major A. T. MOORE, R.E., 1904.

REVISED

By Major E. C. OGILVIE, R.E., 1912.

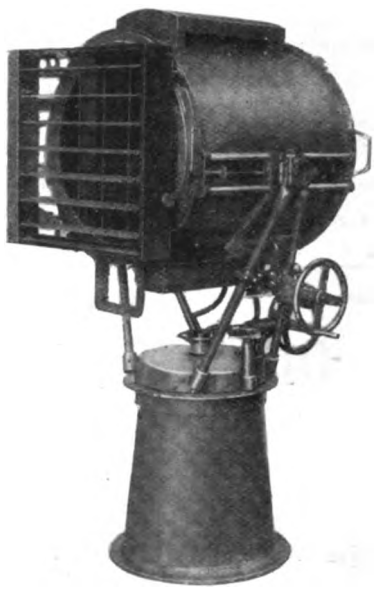
Reprinted by the Council of the Royal Engineers Institute.

Price: To Members of the R.E.I., 2/-; to others, 3/- per copy, post free.

Digitized by Google

SIEMENS

SEARCHLIGHT PROJECTORS



24-inch ADMIRALTY PATTERN PROJECTOR

Prices and Particulars on application.

SIEMENS BROTHERS DYNAMO WORKS LIMITED.

Head Office: CAXTON HOUSE, WESTMINSTER, LONDON, S.W.

Telephone: Gerrard 860. *Telegrams: "Siembralos, London."*

Works: STAFFORD.

BRANCHES:

Birmingham	Newcastle	Sydney	Rangoon	Tokyo
Bristol	Sheffield	Melbourne	Calcutta	Valparaiso
Cardiff	Constantinople	Singapore	Bombay	Buenos Ayres
Glasgow	Johannesburg	Bangkok	Madras	Mexico
Manchester	Cape Town	Penang	Shanghai	Toronto

Digitized by Google

SUPPORT BRITISH INDUSTRIES.

ASBESTOS
CEMENT-SLATES & TILES

Registered
'POILITE'
Trade Mark.

'POILITE' 'POILITE'
ASBESTOS

Roofing Tiles Cement Sheets

'Poilite' is manufactured in accordance with the patent specification of Mr. L. Hatschek, and is in all respects similar to the material sold under the name Eternit.

The characteristics of this indestructible material, both for Roofing purposes and for the lining of walls and ceilings, are well known to Engineers, Architects and Surveyors.

Prompt delivery, speedy fixing by experienced workmen, and immunity from repairs are warranted. Inclusive Tenders submitted on receipt of Plans.

BELL'S UNITED ASBESTOS Co. LTD.

(Contractors to the Admiralty, India Office, War Office and other Government Departments.)

SOUTHWARK ST., LONDON, S.E.

THE SILICATE PAINT COMPANY,

J. B. ORR & Co., Limited.

CHARLTON, LONDON, S.E.,

— *Manufacturers of* —

DURESCO. Washable Water Paint; damp-resisting; cheaper than Oil Paint or Wall Paper.

SILICATE OIL PAINT. Ground stiff in Oil, or ready mixed for use; non-poisonous; finely ground; greater body than White Lead.

ENAMEL PAINTS. High-class Varnish Paints.

"ANCHOR" LINE.

Passenger and Cargo Services.

LIVERPOOL to BOMBAY & KARACHI (*viâ* Bombay). Fortnightly.

LIVERPOOL to CALCUTTA. Fortnightly.
All Vessels call at Egyptian Ports.

Large New Steamers. Splendid Accommodation for Passengers. Electric Light and Fans. Excellent Cuisine. Every Comfort. Moderate Fares, both Single and Return.

Apply—"ANCHOR" LINE (Henderson Brothers), Ltd., Liverpool, London, Glasgow, &c.

SOLE AGENTS

FOR THE

R.E. Institute Publications

(Institute Members excepted):

MACKAY & CO., Ltd.,

CHATHAM.

Digitized by Google

G. E. CARRINGTON,

For many years Master Tailor, Royal Engineers,

TAILOR & MILITARY OUTFITTER,

53, HIGH STREET,
OLD BROMPTON, KENT,

And at CARLTON HOUSE, REGENT STREET, near Waterloo Place, S.W.

HOURS OF BUSINESS:—
Old Brompton, 8.30 to 7.30; Saturdays, 8.30 to 1.
Carlton House, 11 to 6; Saturdays, 11 to 1.

STAINED GLASS

and Church Decoration.

A. O. HEMMING & Co.,

2, Nottingham Terrace, York Gate. **LONDON, N.W.**

Messrs. HEMMING & Co. are executing several heraldic panels for the R.E. MUSEUM, CHATHAM, and have recently filled centre window of ORDNANCE SURVEY LIBRARY, SOUTHAMPTON, with heraldic glass.

DESIGNS & ESTIMATES ON APPLICATION.

TELEPHONE 195. TELEGRAMS :—BECKWITH, WINDSOR.

IMPERIAL SERVICE COLLEGE,

WINDSOR.

Chairman of Governors:
H.S.H. PRINCE ALEXANDER OF TECK, D.S.O.

Head Master: E. G. A. BECKWITH, M.A.
(Late Head Master, The Army School, Holyport, Berks.)

The College, which has been entirely reorganised, is divided into two departments, Military and Civil.

Especial attention is directed towards the Military side where there are 45 boys, for whom are allotted 7 Resident Masters of long and successful teaching experience.

SUCCESSES, JULY, 1911—JULY, 1912.

Eleven into Sandhurst—one Scholarship, four into Woolwich, and three into Greenwich (Royal Marines) also Qualifying for Special Reserve, etc.

The Civil side includes preparation for the Universities, Engineering, etc.

A SPECIAL FEATURE

Is that of the instruction given to boys intended for Colonial Life—the College Farm and Estates being applied to this object.

CHARACTERISTICS.

The three main objects of the College are :—

1.—Teaching in Small Classes.
2.—A "Modern" Curriculum.
3.—Comparative Lowness of the Fees (£81 per annum for Sons of Officers).

For further PARTICULARS apply to the Bursar.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

JAN 10 1913

Digitized by Google

Digitized by Google